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ABSTRACT

The primary purpose of this survey was to bring about closer contacts between vocational education and the electrical and electronic goods industry of Israel. In addition to a review of literature, engineers and managers were surveyed, via questionnaires, with respect to: (1) The various occupations existing in electricity and electronics, (2) subjects learned, (3) duration and type of training given to electricians and electronics technicians, and (4) the number of graduates of vocational schools presently working and needed in the future. It was found that the graduates' level of knowledge and extent of training are satisfactory; however, many felt that the requirements need to be raised in several areas. It is anticipated that the number of electricians and electronics technicians in Israel is likely to amount to three times the present number in the next few years. (GEB)

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THE HENRIETTA SZOLD INSTITUTE
NATIONAL INSTITUTE FOR RESEARCH
IN THE BEHAVIORAL SCIENCES

VOCATIONAL SCHOOLS: RELATION OF CURRICULA TO NEEDS IN THE FIELDS OF THE ELECTRICAL AND ELECTRONIC INDUSTRIES

BY
ESTHER NITZAN

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Jerusalem, March 1969

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Thanks are also due to the firms' managers and engineers who devoted their time and patience to answering the questionnaire and the interviewers. Heartfelt thanks to them all.

E. Nitzan

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Introduction

This survey is intended to bring about closer contacts between vocational education and the electrical and electronic goods industry. Accordingly, the survey's starting point is an examination and criticism of the curricula to be found in vocational schools at the various levels (courses) in the electrical and electronic trends.

A number of fundamental questions were introduced into the main body of the survey: do the vocational school graduates meet the requirements of industry for theoretical and practical knowledge, being aware of the industry's present and future needs? What are the qualitative and quantitative changes required in the subjects learnt at vocational schools in order to suit the graduates to the industry in its present situation and to its predicted growth? What type and duration of training are required for the various industrial occupations with a view to the future?

In order to find an appropriate answer to these questions, we applied to the engineers and managers of firms in the electricity and electronics industry. It turned out that the members of this industry were, in fact, able to make a contribution to this subject since most of the graduates are absorbed in industry and fulfill its requirements. Most interesting too are the comments, recommendations and proposals of those supervising the acceptance of the graduates and their integration into electrical and electronic occupations (see previous paragraph).

Since this survey is intended, as already stated, to bring about closer contacts between vocational education and the electrical and electronic goods industry, a review of the literature is also given, both on the vocational education and on the electricity and electronics industry (Section I).

This review examines, among other things, the extent of integration of the vocational training and its graduates within the framework of technological manpower and secondary education. It also presents some data on the planning and extension of vocational education in Israel; it covers the stages of the industry's development in Israel and the world and details of its various components; it also examines the special character of the production, marketing and development of electronic goods and gives a follow-up forecast of these industrial branches and their predicted development up to 1970.

The survey's findings reflect only the opinions of the engineers and the personnel managers in the various firms. The survey does not take pedagogic considerations into account and does not go into an analysis of teaching methods and the like. (This survey should not be regarded as reflecting the views of the writer or the Szold Institute).

The survey was begun after the Six-Day War and the material was collected during approximately ten months. Since this period, as is well-known, was replete with changes and vicissitudes and in view of the fact that the literary review was composed on the basis of sources written before that war, some of the review's data and findings may have become somewhat out-of-date before their publication.

Section I - Review of Literature

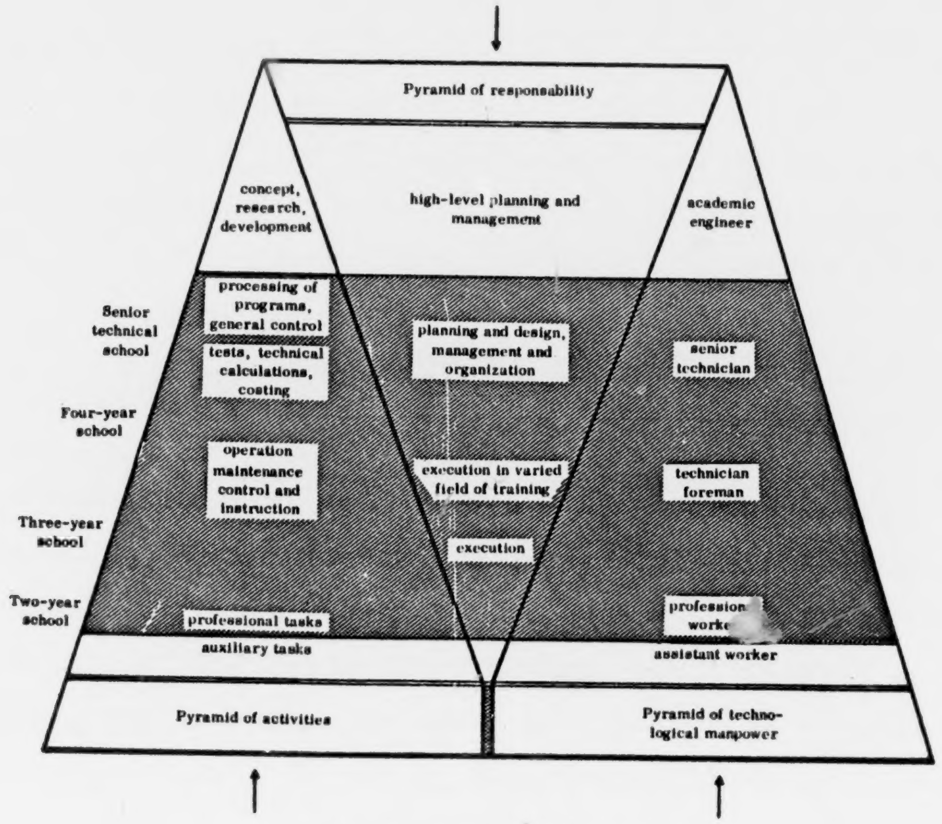
A. Preface

The principal aim of the survey, as mentioned above, was to examine the curriculum usually to be found in vocational schools at the various levels in the fields of electricity and electronics. For this reason it is necessary to review the situation of the electricity and electronics industry in Israel and abroad, its predicted future development and the extent to which vocational training at the various levels of study is suited for this industry in its situation today and in the situation in which it will find itself in the near future.

This review, which obviously relies on the scientific literature on the subject, has been carried out in two main spheres: that of vocational education and that of the electricity and electronics industry.

In order to study the connection between these two spheres i.e. the amount of theoretical training required by each type of worker in the electrical and electronic professions, a pyramid is presented, showing the structure of technological manpower, distributed according to the levels of training needed by each type of professional worker.

Table 1: Structure of Technological Manpower


Pyramid of responsability
concept, research, development
high-level planning and management
academic engineer
Senior technical school
processing of programs, general control
tests, technical calculations, costing
planning and design, management and organization
senior technician
Four-year school
operation maintenance control and instruction
execution in varied field of training
technician foreman
Three-year school
execution
Two-year school
professional tasks
professional worker
auxiliary tasks
assistant worker
Pyramid of activities
Pyramid of technological manpower

*) From 20 Years of Vocational Training in the State of Israel, the Ministry of Education and Culture, 1968.

The above pyramid reveals that with a rise in the level of training, there is an increase in the worker's responsibility and in the level of operations performance demanded of him: the unskilled and skilled worker are required to carry out auxiliary and skilled tasks only; the technician and foreman are required to execute tasks in a varied field of training, operational tasks, maintenance, control and instruction; the senior technician is charged with planning and design, management and organization, processing of programs and general control, tests of technical calculations and costing; high-level planning and management, concepts, research and development are required of the academic engineer.

Our concern in this survey is the shaded area of the pyramid which includes: the senior technician, technician, foreman and skilled worker. Thus the levels of study required by this manpower - as demonstrated by the pyramid - which shall be discussed here are: the senior technical school, the four-year vocational school, the three-year vocational school and the two-year vocational school.

B. Vocational Education

As stated, we are concerned in this survey with four levels of vocational schools: the two-year, the three-year, the four-year and the senior technical school. In order to study the nature of these theoretical-vocational levels and their degree of suitability to the requirements of the electricity and electronics industry, details will be given of the scientific literature dealing with the various aspects of this sphere.

1. The position of vocational education in Israel and other industrial nations in 1963/4:

Israel is not included among those nations which are underdeveloped from the viewpoint of financial investment in education or of the general percentage of pupils attending secondary schools. However, there is a noticeable backwardness in the ratio between those studying a vocation and those studying at ordinary secondary schools in Israel. In order to show this relationship, table 2 is presented, consisting of data published in the official yearbook of UNESCO, 1963/4. (The details of the table and the data of this paragraph were all taken from: Ort in Israel, October 1967).

For purposes of comparison, we took four developed countries in Northern and Western Europe. In none of them does the financial investment in educational needs as a percentage of total national income exceed that of Israel.

Table 2: A comparison of some data* on vocational training** in a number of developed countries

Country	Expenditure on education as a percentage of national income	Number of pupils in vocational and agricultural education	Number of vocational pupils per 1,000 inhabitants	Vocational pupils as a percentage of all pupils in secondary education institutions
Belgium	7.1%	app.500,000	app.48.0	app.60%
Holland	7.3%	545,429	45.8	52%
Denmark	6.7%	157,937	33.6	55%
Sweden	6.8%	205,138	26.8	47%
Israel	8.4%	50,000	20.0	40%

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[*] The figures in this table refer to pupils studying within the Ministry of Education and Culture's framework.

[**] The term "vocational education" in this table includes agricultural education which by its very nature is education towards professional work.

The percentage of vocational pupils is twice as large in Sweden and 2½-3½ times as large in Belgium, Holland and Denmark. The difference is particularly outstanding when a comparison is made of the absolute numbers of the hundreds of thousands of vocational pupils in each of these countries with the mere tens of thousands in Israel.

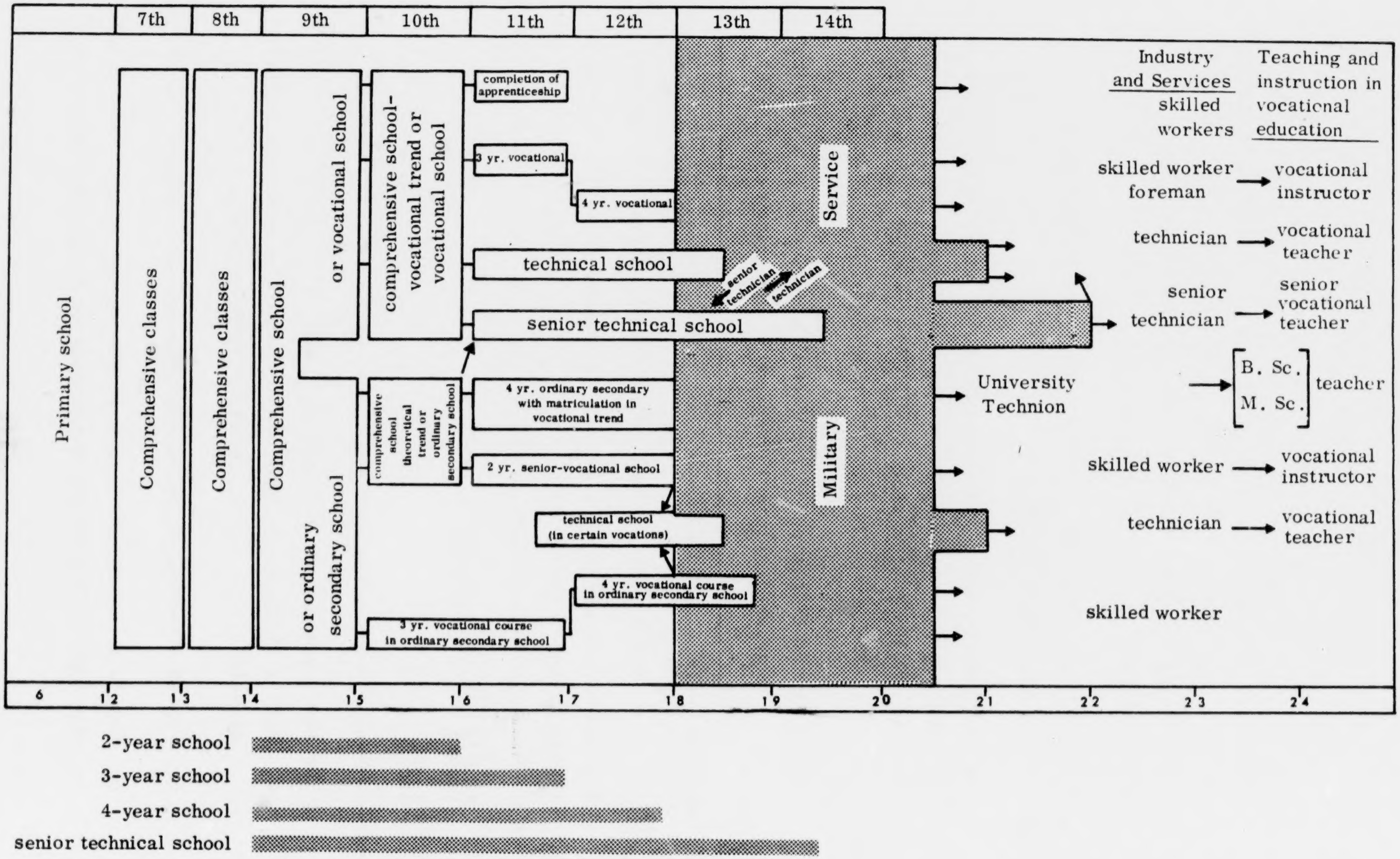
The situation is explained in the last column of the table which shows the vocational pupils as a percentage of all pupils in secondary schools: in three of the countries in the sample, the majority learn a vocation; in Sweden the number learning a vocation amounts to 47% whereas in Israel it amounts to 4o% only. (The percentage learning a vocation in Israel actually increased during the last three years but is not yet equal to that of other nations which, thanks to their achievements in vocational education, have created a wide basis for the development of industry: professional manpower.)

2. Methods of vocational education in the framework of secondary education:

According to table 3, on the one hand, vocational education is penetrating the sphere of primary schools in the form of comprehensive classes with a vocational trend, which continue upto the 9th grade. On the other hand, secondary vocational education continues upto the age of military service and then trains technicians and senior technicians. Graduates of all the courses are entitled to receive a state certificate on the completion of their studies after passing external examinations.

The various vocational education courses take place at different levels: the lowest level is the short course whose maximum duration is two years (hereinafter: vocational course). These courses in which are included the 2 year vocational schools, train skilled workers and their assistants and they are intended for 14-16 year olds, graduates of the 8th grade. The three-year vocational school is meant to train professional workers at higher level and is intended for 14-17 year olds in the 9th-11th grades. The higher level of vocational education is the four-year vocational school which it is intended to transform into a technical school. The graduates of this level are capable of being employed as foremen, in operation, maintenance, control and instruction. The technical school course lasts 4½ years and is intended for 14-18½ year-olds. The higher level is senior technician level intended for 14-19½ year-olds. Its graduates receive appropriate training for planning, design, management and organization. They are capable of undertaking program processing, general control, testing, technical calculations and costing.

Table 3 : Vocational education methods in the secondary education system of the State of Israel – proposed change


7th
8th
9th
10th
11th
12th
13th
14th
Primary school
Comprehensive classes
Comprehensive classes
Comprehensive school
or vocational school
or ordinary secondary school
comprehensive school-vocational trend or vocational school
comprehensive school theoretical trend or ordinary secondary school
completion of apprenticeship
3 yr. vocational
4 yr. vocational
technical school
senior technical school
4 yr. ordinary secondary with matriculation in vocational trend
2 yr. senior-vocational school
technical school (in certain vocations)
4 yr. vocational course in ordinary secondary school
3 yr. vocational course in ordinary secondary school
senior technician
technician
Service
Military
University
Technion
Industry and Services
skilled workers
Teaching and instruction in vocational education
skilled worker foreman
vocational instructor
technician
vocational teacher
senior technician
senior vocational teacher
B. Sc.
M. Sc.
teacher
skilled worker
vocational instructor
technician
vocational teacher
skilled worker
6
12
13
14
15
16
17
18
19
20
21
22
23
24
2-year school
3-year school
4-year school
senior technical school

From : 20 years of Vocational Training in the State of Israel, Ministry of Education and Culture, Jerusalem, 1968

The main reasons for the existence of the different levels of training are first of all the different abilities of the pupils, not everyone of whom is capable of attaining the higher levels, and secondly the needs of the economy which demands different levels of professional workers.

3. Vocational schools in Israel, 1967/8, and their distribution according to vocational trends:

In the 1967/8 school year the Department of Vocational Education in the Ministry of Education and Culture comprised 218 vocational and technical schools, in which 40,379 pupils studied - 23,179 of them boys and 17,200 of them girls.

Table 4: Distribution of vocational school pupils according to grade level in 1967/8 and a comparison with 1966/7

Total no. of pupils		9th grades		10th grades	11th grades	12th grades	13-14th grades
1966/7	1967/8	1966/7	1967/8	1967/8			
34,835	40,379	14,597	16,442	12,338	8.244	2,822	533
+5,544=	+ 15%						

The above numbers do not include:

a. Pupils studying in vocational courses in ordinary secondary schools .... (approx. 4,000 pupils)

b. Pupils studying in naval schools .... (approx. 1,500 pupils)

c. Pupils studying in schools of the Israel Defence Forces under the supervision of the Department of Vocational Education.

These pupils have the possibility of choosing between 20 technical subjects and 19 non-technical subjects which are offered them within the framework of the vocational schools.

Table 5: Distribution of vocational school pupils according to trends in 1967/8 (rounded to the nearest percent)

Technical subjects	1967/8	(1966/7)
Metal	23%	(26)
Electronics	11%	(8)
Electricity and Tool operation	10%	(9)
Machinery	9%	(9)
Carpentry	4%	(4)
Machine and construction drawing	2%	(3)
Textiles	1%	(1)
Printing	1%	(1)
Non-technical subjects		
Administration, secretarial work office mechanization and office work	19%	(19)
Fashion, sewing and knitting	11%	(11)
Home economics	4%	(4)
Applied art	1%	(1)
Laboratory workers	3%	(3)
Miscellaneous	1%	(1)
Total technical subjects	61%	(approx. 25,000 pupils)
Total non-technical subjects	39%	(approx. 15,000 pupils)
Total	100%	

(From: 20 Years of Vocational Education in the State of Israel, the Ministry of Education and Culture, 1968)

It is worth mentioning that quite a considerable change has taken place in the relative weight of technical subjects in recent years. The phenomenon is particularly outstanding in the relationship between the metal trades and the electrical and electronic professions: at the end of the 1950's nearly half of the pupils studied metal trades whereas today the latter are learned by only a quarter of the pupils due to the rise in the number of pupils studying electricity and electronics.

4. Apprentice schools

Apart from the vocational schools which are under the supervision of the Ministry of Education and Culture, Israel has also a number of apprentice schools. The latter combine study with practical work in various firms. These schools are divided, according to the amount of training given, into five categories:

Apprentice schools - intended for boys or girls learning a vocation while working at workshops or industrial enterprises. The apprentices work five days a week and one day a week is devoted to theoretical studies at these schools. Studies are held for nine hours and include the humanities, sciences and technology. The duration of the studies is two or four years according to the vocation learnt.

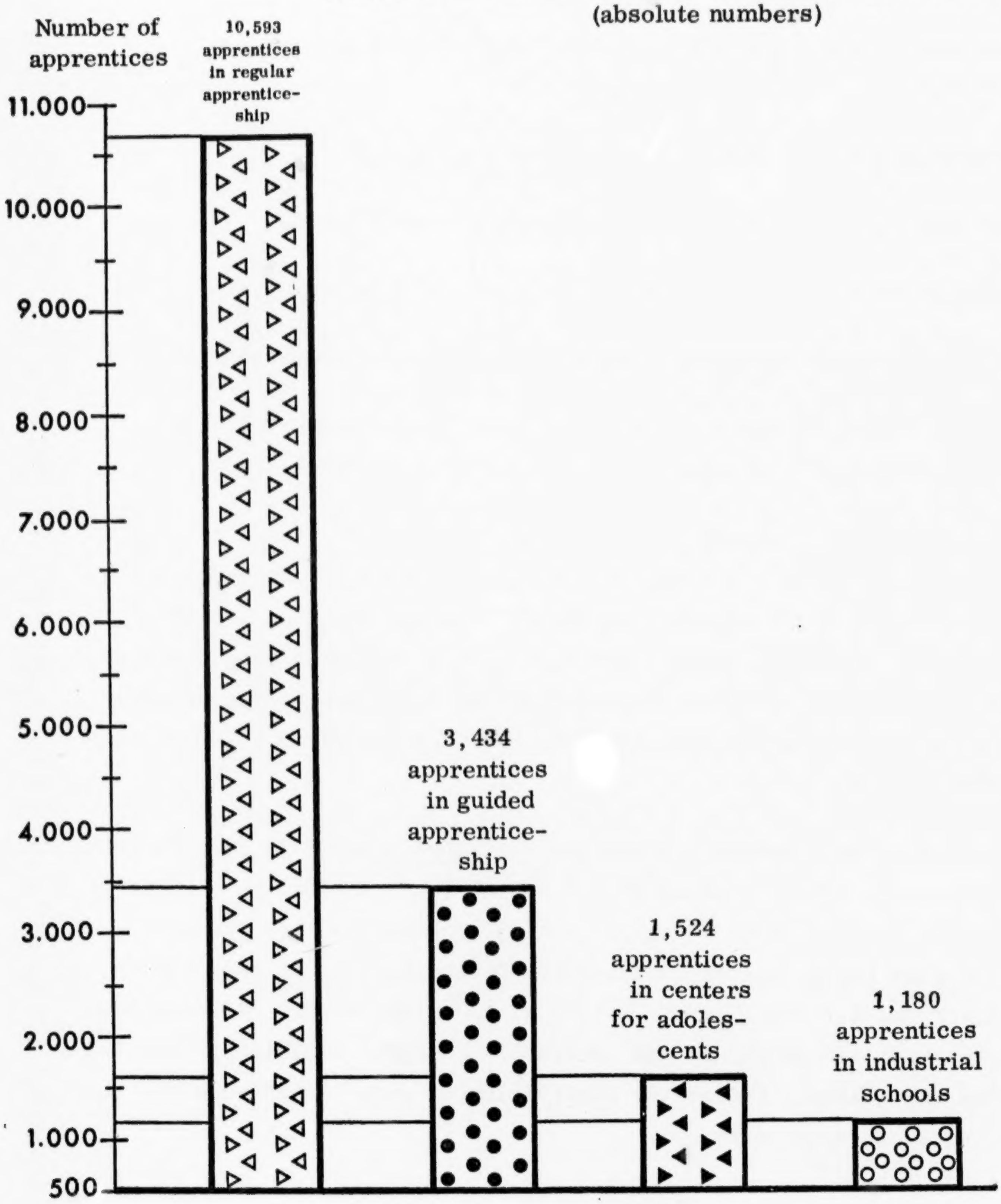
Intensive study classes - in the framework of apprentice schools - intended to provide those youths who aspire to advance with additional theoretical studies in accordance with the curriculum of the vocational secondary school. Studies are held two evenings a week in addition to the regular study day.

Guided apprenticeship - is an educational framework whose aim is to provide practical vocational training and general technological education during one school year within the schools' precincts. Another two years are spent by the apprentices in industrial schools or regular apprenticeship.

Industrial schools - are attached to a firm and the vocation studied there is suited to the type of production. The school contains a study workshop where the youths are given practice in practical work through productive work for the firm. Half the study hours are devoted to theoretical studies.

Courses for adolescents - intended for youths who are approaching the age of conscription and are dropped out of study frameworks or, for various reasons, have not learnt any vocation. Since the duration of study in the courses is only one year, learning is intensive. Most of these courses are held in co-operation with the Israel Defence Forces and the participants continue to work in the vocation learnt.

Table 6 : The various trends in apprenticeship, 1967/8
(absolute numbers)



5. Levels of training in electricity and electronics within the Ministry of Education and Culture's framework

The educational system trains electricians and electronics technicians at five professional levels:

1. Academic level - engineers, graduates of the Technion (Israel Institute of Technology).
2. Senior technician level - senior technical school.
3. Skilled level - 4-year vocational school (technicians).
4. Skilled level - 3-year vocational school (skilled workers).
5. Skilled level - vocational course or 2-year vocational school.

Since this survey is concerned with the last four levels (2,3,4,5) details of the study frameworks of each level will be given separately:

Senior technicians (4 institutions in the 1966/7 school year) - Studies in this framework begin in grade 11. The pupils study 3½ to 4 years after grade 11 (some 4,500-5,000 study hours). During this period they receive training in the execution of the following tasks: participation in research projects alongside academic engineers and scientists, development and experimentation, design, planning and calculation, operation and planning, maintenance and technical management of medium sized enterprises.

Technicians (3 institutions in the 1966/7 school year) - in the framework of the senior technicians school a third of one school year is added to the 4-year school (300-400 study hours). This addition provides the pupils with special learning which entitles its graduates to the title "technician". In this school they are trained for the following jobs: detail of planning, control and organization, order of equipment and materials and laboratory testing, auxiliary tasks for senior technicians and academic engineers, supervision of work performance and management of production departments.

Vocational schools - these institutions provide systematic training whilst combining theoretical study with practical training. Study is provided in a number of courses which are determined in accordance with the duration of the training: 2-year course, 3-year course and 4-year course.

Apart from these levels of training which are the principal ones in electrician and electronics technician training, there is another course of vocational study within the Ministry of Education and Culture's framework, namely:

Vocational trends in ordinary secondary schools - (51 schools for Jewish pupils and 3 schools for minorities in the 1966/7 school year). Within this framework, 25 study hours per week are devoted to general subjects, in accordance with the syllabi of the ordinary secondary school and about another 17 hours per week are devoted to vocational-theoretical and practical-subjects, in accordance with the syllabi of the vocational school.

In order to receive a more precise and detailed idea of the syllabus typical of each of the study courses, the distribution of the time is given in table 7.

As far as this syllabus is concerned it should be noted that there are certain deviations in the various subjects, especially in the technical-theoretical and practical ones.

Table 7: Distribution of weekly study hours in the various courses

Subjects	2-year		3-year			4-year			
	9	10	9	10	11	9	10	11	12
Humanities*	13	12	10	9	8	10	9	9	8
Sciences	7	7	7	7	4	7	9	8	4
Technical-theoretical	5	6	5	7	12	5	5	7	12
Technical-practical	16	18	18	18	18	18	18	18	18
Miscellaneous**	4	8	4	4	3	4	4	4	3
Total hours per week	45	47	44	45	45	44	45	45	45

* In religious vocational schools, approximately three more hours per week are devoted to studying Judaism.

**Education, physical training, "gadna"-youth military units.

(from: 20 Years of Vocational Training in the State of Israel,
The Ministry of Education and Culture, 1968).

6. The number of vocational school graduates in electricity and electronics and the predicted increase.

The number of pupils completing their studies in electronics today (1968/9) is six times as high as the number in 1961/2. The number completing their studies in electricity increased seven-fold in the same period. Up to 1974 a sisteen-fold increase is anticipated in the number of guaduates in electronics and a ten-fold increase is anticipated in the number of graduates in electricity (as compared with 1961/2).

Apart from examining the increase in the general number of graduates we must also see to what extent the number of graduates increases at each of the different levels of training. But an important fact must be stressed here: the data in table 9 were collected before the Six-Day War and it may be assumed that they are no longer up-to-date. In the absence of other information, the data are presented as they are and for this reason no comparison has been made between these data and the data in table 8 which were supplied after the war.

Table 8: Graduates of the Ministry of Education and Culture's vocational schools in the fields of electricity and electronics (rounded numbers)

School Year	Electronics: No. of Graduates	Electricity: No. of Graduates	Candidates for labour market in year (after military service)
1961/2	130	100	1965
1962/3	180	100	1966
1963/4	200	200	1967
1964/5	230	200	1968
1965/6	150	300	1969
1966/7	350	400	1970
1967/8	500	500	1971
1968/9	800	700	1972
1969/70	1,100	800	1973
1970/1	1,300	900	1974
1971/2	1,600	1,000	1975
1972/3	1,800	1,000	1976
1973/4	2,000	1,000	1977

Table 9: The increase in workers at technician level in industry[+] (according to main groups) 1962-1970

	Total no. of technicians	Metal technicans	Chemical and food technicians*	Various technicians, electricity and refrigeration**
1961 - total no. of employees	3,750	1,680	840	1,230
As percentage of total no. of employees	100	44.9	22.4	32.7
Net addition	3,640	1,700	570	1,370
Percentage increase	97.0	101.2	690	111.4
Gross addition	4,300	1,980	850	1,420
1970 - total no. of employees	7,390	7,380	1,410	2,480
As percentage of total no. of employees	100	45.7	19.1	34.0

* Include laboratory workers at technician level.

** Includes electronics.

[+] Data also include foreman whose vocational training is equivalent to technician level.

The rate of increase in the number of technicians between 1962/3 and 1970 in manpower planning is 97% and their weight among the total number of employees in industry will increase from 1.9% to 2.4%.

At technician level a very high rate of increase is required both in view of the present shortage of technicians and due to the increase in mechanization and modernization; moreover, training institutions have not yet been established to a sufficient extent at this important level. Today there are quite a few cases where engineers are doing the jobs of technicians and this waste of precious manpower must be halted.

Table 10: The increase in skilled workers in industry (according to main vocation) 1962-1970

	Total skilled workers	Laboratory workers*	Electricians	Metal	Wood	Specific cases and misc.
1962 - total	76,130	630	5,500	24,600	10,210	35,200
As percentage of total no. of employees	100	0.8	7.2	32.3	13.4	46.3
Net addition	43,410	580	3,460	21,340	2,270	15,770
Gross addition	60,100	620	4,410	27,590	6,240	21,240
1970 - total no. of employees	119,540	1,210	8,940	45,940	12,480	50,070
As percentage of total no. of employees	100	1.0	7.5	38.4	10.4	42.7

* Exclude laboratory workers at technical level.

Note: In this table, specific workers in the metal trades have been added to the "metal" column.

The findings with regard to the level of skilled workers express the different trends of development - which are partly opposed to each other - in industry in years to come. On the one hand, a polarization process is taking place which is preventing the increase of some of the skills among all the workers. This is particularly true of the "specific skilled" workers in direct production in the various branches. On the other hand, the process of improvement in the present situation, additional mechanization and the like are leading to a rise in the proportion of skilled maintenance and laboratory workers. Thus we are obliged to study this development together with its internal composition in order to receive significant results.

The overall rise of this group between 1962 and 1970 is estimated at 57%.

C. The electricity and electronics industry

1. The situation in Israel:

The production of a large part of the output in the electromechanical equipment branch as well as of electronic goods is suited to the conditions of the Israeli economy. These industrial branches are based to a considerable extent on engineering planning and skilled labour whereas the raw materials component, in which Israel is poor, is small. In the electronics industry the fixed investment in production assets is also a factor of relatively little weight. On the other hand, the investment in research and development in the electronics industry reaches very large dimensions. Continuous finance of large investments in research and development constitutes a prerequisite for the existence and development of the electronics industry.

Of the main sub-branches, that of electromechanical equipment is the oldest. During the period of its existence this sub-branch has gradually turned to producing heavier and more complex goods whilst reducing imports so that it supplies some 80% of the country's needs at an international quality and standard and at reasonable prices.

The quality of the goods of the electromechanical equipment branch is of international standard. This is due to the first-rate engineering and technical manpower employed in the branch and the great know-how that has accumulated in it. As regards a number of products, agreements exist with well-known firms abroad which supply current information to local establishments. The self-knowledge which crystallized and was developed here has enabled local enterprises not only to "digest" the information received from abroad but also to use it in developing new products and introducing modifications in similar products.

The electromechanical branch is at the forefront of the other metal and electricity branches in the degree to which it participates in applied research. The research is being carried out, for instance, in the fields of isolation and radial engines but an extensive field has remained as yet unexplored: the discovery of desirable data for the construction of electrical equipment with the assistance of electronic computers, the study of the influences of sand and water on engines, the development of components for regulation and control and so on.

Regarding telecommunication products, there are agreements for the supply of current information between local firms and well-known firms in England and Switzerland. With the help of these informational contacts, local firms are producing goods, such as telephones, at a high standard from a quality point of view, and they are also gradually going over to producing new goods such as local telephone exchanges, carrier equipment and other equipment for trunk dialing.

It should be noted that good prospects for developing the local market and particularly exports lie especially in those products of electrical equipment which are of a specific and complex nature and whose production necessitates a high input of engineering planning and skilled assembly. There is still a lot to develop in this direction in the light of the experience of small countries such as Switzerland and Denmark which possess technical manpower similar to that found in Israel.

In order to obtain a general picture of the state of the electricity and electronics industry in Israel, the following table is presented giving data on the number of employees, output and export.

Table 11: Employees, output and exports in Israel's electricity and electronics industry

No. of employees	Output (IL1,000)	Exports ($1,000)	No. of employees	Output (IL1,000)	Exports ($1,000)	Predicted investment up to 1970 (IL million)
6,900	111,500	1,600	14,900	32,200	18,400	113.8

(From: Program for Israel's Industrial Development 1965-1970, Forecast B, Ministry of Commerce and Industry, 1965)

2. The problems of the industry:

The problems of the industry arise from the limited scope of the market and the industry's fragmentation. It is the usual thing in the world today to go over to mass production of consumption goods, especially electrical ones. Generally speaking, however, the size of the local market in Israel does not justify the establishment of large-scale units of production. Nor can the industry rely on the export market alone since, due to the great degree of innovation in the branches' products, it needs an extensive hinterland. It would appear that there is more room for the development of those branches where products are more specialized and whose production does not require a lot of mechanization.

3. Development of the branch:

Upto 1970 output will increase three-fold - a higher rate than that anticipated in industry generally. The increase is particularly outstanding in electronics and telecommunications as well as in those branches producing engines, transformers and electrical equipment for the cable industry.

According to an estimate (from: Program for Israel's Industrial Development, Jerusalem, 1965) approximately 8,000 more workers will be required towards 1970; of these, some 640 engineers and technicians, 3,800 skilled workers and 3,560 semi-skilled workers. These figures indicate a - relatively and absolutely - high concentration of first-rate workers.

The great increase in the output of this branch may be attributed to the expansion of the variety of goods whilst reducing imports, especially of the heavier and more complex products, to the beginning of the production of new types of goods which are as yet not in use and to the increase in mechanization and the use of electrical equipment in industry. The considerable advance in exports which is anticipated should also be mentioned. The prominent expansion in the telecommunications branch is connected with the Post Office's development plans and refers to the expansion of output in existing products as well as the production of new ones such as local exchanges, carrier equipment and other equipment for trunk dialing.

The main branches in which extensive investment is to be expected in future include: engines, large transformers (over 10,000 kwh), welding machines, equipment for electrical installation in houses and for industry and electric cables.

It can be generally stated that the development plans necessary for the period until 1970 should be based on existing plants. This is particularly the case with regard to electrical equipment products. This is both necessary and desirable because existing plants must be given to possibility of benefiting from the additional output forecast for both local and foreign markets so that they may transform themselves into mechanized units of production on a scale usually to be found abroad. In this way it will be possible to make production cheaper and more efficient. There will be room to discuss and encourage, if necessary, the establishment of additional units of production only towards the end of this period.

D. The electronics industry

Till now, our discussion has been of a general nature and has dealt with the electricity and electronics industry as a whole. However, a special discussion should be devoted to the electronics industry itself. Such a separate discussion is justified by the industry's great importance and the extent of its increasing development.

The electronics industry is usually divided into four sub-branches:

(1) Electronic consumer goods - including radio and television receivers, gramophones, tape recorders, etc.

(2) Communications equipment - including telephone appliances, carrier equipment, etc.

(3) Electronic equipment - including measurement, monitoring and control instruments, computers, etc.

(4) Electronic components - including electronic receivers semi-conductors, relays and cables, etc.

1. The development of the electronics industry in the world*

The development of the electronics industries in the western hemisphere was most dynamic. This fact is reflected by the following data:

Total annual turnover in 1946 was approximately $2 billion;

Total annual turnover in 1960 was over $16 billion.

The share of the "Big Six" (U.S.A., Britain, West Germany, Japan, France and Holland) in the above turnover was approximately 90%.

It should be noted that in the United States the electronics industry grew 27-fold in the last 25 years whereas national output grew 5.5-fold only.

Between 1960 and 1962 output in the United States electronics industry grew from $9.8 billion to $14.5 billion. During the same period output in Japan grew from $1.1 billion to $1.6 billion. In both cases the increase was in the region of 50% during two years.

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* Data on the electronics industry in the world are taken from the report of the Stanford Research Institute on the electronics industry in Israel.

The general turnover of the electronics industry in 1960 consisted of three main groups: industrial electronic products, which accounted for 40%; consumer electronic products - 23%; and components - 37%.

The weight of consumer goods in the general production has gradually decreased in the past with the rise in the weight of industrial electronics. For instance, the share of consumer electronic goods in the United States fell from 50% in 1950 to less than 20% in 1960.

2. The special nature of the production, marketing and development of electronic goods:

Production - if we overlook a few isolated cases which are especially typical of component production, we shall see that most production takes place today by means of relatively simple productive installations and assembly is done manually.

Most industrial electronic products are small and leight in weight.

Marketing - the specific nature of the goods requires a form of marketing which is not usually found in other industrial branches. A considerable percentage of the electronics industry's products are marketed directly to the consumer by special sales engineers.

The sale of components also requires considerable technical knowledge since in many cases the producer must explain to the components' user what possibilities of using them exist.

Research and development - the electronics industry is typified by the rapid development and continuous innovation of its products. Over 8% of the products have been modified in one way or another within a five-year period.

The expenditure on research and development in the industry in the United States amounts to 10% of the turnover on the average. In firms which are developing specific products for the military, this expenditure reaches 20% of the turnover.

Manpower - the electronics industry is based on first-rate professional manpower. The percentage of engineers and technicians required is extremely high as compared to other branches.

A survey made on the subject in France gives the following picture of the electronics industry:

Table 12: Management, engineers and officials as a percentage of total employees

	Consumer goods, %	Industrial goods, %	Components %
Management, engineers and officials	28.5	55.7	28.0
Production workers	71.5	44.3	72.0
Total	100.0	100.0	100.0

One of the typical features of this industry is the high proportion of female labour in the production and assembly stages. There are two main reasons for this: first, it turned out that women are more suited to assembling miniature and delicate components; secondly, they are paid lower wages.

3. The role of governments in the development of the electronics industry

The governments of various states have realized the great role played by the electronics industry within the framework of general industrial development and of meeting the demands of the defence departments. This awareness has led governments to support this industry directly and indirectly. In the United States, for example, the largest customer of the electronics industry is the military which purchases approximately 50% of the branches' output. The military also participates in 75% of the sums spent by electronics firms on research and development.

In England, the Post Office constitutes the biggest consumer of electronic equipment and the planning and development of many establishments are facilitated by its assistance.

The Canadian government grants considerable income-tax relief to the electronics industry; research and development expenditure is recognized as a current expense for income-tax purposes.

The most vigorous state support in developing the electronics industry is to be found in Japan. The latter's government has adopted a policy of controlling and directing research, production and quality and this has led to a tremendous development of the branch. It should be noted in particular that the Japanese authorities do not constitute large potential consumers of the electronics industry's products in view of the absence of military requirements.

E. The electronics industry in Israel

1. Stages in the industry's development:

The electronics industry in Israel is still in its early stages. The industry's turnover represents about ¼% of the national income whereas in Italy, for example, it constitutes 1.4% and in Holland - 5.5%.

The industry as a whole actually began to develop in the early 1950's. The main development took place in the assembly and production of various kinds of radio instruments.

The development of 'non-entertainment' electronics was slower. In the first stage a number of firms assembled internal communications instruments and installed external communications instruments as well as giving their purchasers service. At the same time one firm began to produce crystals. Later, in the mid-1950's, the planning and production of industrial electronic installations began.

In the early 1960's one firm began to develop special electronic measurement instruments part of which constituted an innovation on the world market.

In 1962 some 30 firms were engaged in assembly and production of electronic products. The general turnover of the branch amounted to IL 13.5 million, of which IL 10 million represented various consumer goods (radio sets, gramophones, etc.). The branch employed approximately 1,000 workers. These figures (of output and employment) do not include the firms belonging to the defence network. The high technological standard of the industry today ensures rapid development within a short time in the field of professional electronics and a halt to the concentration by the firms on consumer electronic goods such as radios and the like.

2. Employment and manpower:

The firms in the electronics branch may be divided into two main groups: one, very limited group of firms engaged in independent research and development; and a second, larger group of firms which are engaged in the assembly of products or the production of standard components.

A growing shortage of first-rate manpower is being felt in the electronics branch for two reasons:

(1) Reduction in supply: many good engineers did not find their place in the framework of the local industry, which at the time was at the beginning of its development, and they emigrated.

(2) Rise in demand: the expansion of the industry in recent years did not equal the rate of growth in the number of skilled workers in the branch.

Nevertheless, it may be assumed that the increase in skilled manpower originating in local educational institutions, will be able to meet the future requirements of the branch and that the development of the electronics industry will in any case reduce the emigration of first-rate manpower from Israel.

All the aforegoing refers to firms in the civilian sector and does not take into consideration the unknown quantity of demand for manpower on the part of the defence network.

3. The development of the branch in recent years:

The rapid development of the electricity and electronics branch during the past two years has confirmed the assumption that it has a great future in store. This industrial branch is based to a considerable degree on engineering planning and skilled labour whereas the raw materials component, in which Israel is poor, is small.

The main development in the past two years was in import replacement. In a number of cases, such as communications instruments and telephone exchanges, imports were substituted by local assembly of imported parts. This stage in the development process usually precedes a deepening of production and the beginning of local production of components.

Table 13: The increase in output* in the electrical and electronic equipment branch, 1962-1964 (IL million, 1962 prices)

Branch	1962	Index	1963	Index	1964	Index
Electric motors and transformers	17.5	100	20.0	114	19.4	111
Electrical installation and lighting equipment	41.1	100	51.9	126	60.7	148
Batteries and accumulators	7.5	100	8.7	116	10.1	135
Domestic electrical appliances	11.6	100	11.7	101	20.1	173
Radios and gramophones	11.0	100	11.6	105	11.7	106
Communications equipment and accessories	8.1	100	18.5	228	35.3	435
Total	96.8	100	112.4	110	157.3	162

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* Does not include services, repairs and independent workers.

Of all the sub-branches, that of communications equipment and accessories saw the most rapid development. The increase came mainly from telephone appliances and telecommunications equipment.

The electronics branch also expanded rapidly, especially in the field of communications equipment which replaced imports. In the electromechanical branches, the most rapid development took place in electric cables and wires. The development of electric motors and transformers output was slower than anticipated, mainly as a result of the decline in exports.

In the group of branches producing electrical appliances for domestic use, the rapid rise in output originated mainly from two products: mixers and vacuum cleaners. These products are generally at the end of the consumers scale of priorities and their purchase is characteristic of a high-income group. The rapid rise in per capita consumption beyond what was predicted had a considerable impact on the rise in local demand for these products and pushed it beyond expectations. Local production of radios and gramophones dropped due to the saturation of the local market and the increase in purchases of imported transistor radios and gramophones. The fall in output was slowed down to a certain extent by the increased production of radios for automobiles.

4. Trends of development and proposals for its promotion:

It is not worthwhile developing or producing standard goods which are produced abroad in very large series and by means of the most modern means of production. This is the case with both standard components and entertainment electronic products.

The Israeli electronics industry has the possibility of fitting into the world cycle of production of non-standardized goods which are not produced in large series and are meant for specific purposes, industry and research. Various research works have shown that the goods to be preferred for local production are:

(1) Control and measurement apparatus for industry, equipment and laboratories.

(2) Medical equipment.

(3) Educational equipment.

(4) Specific equipment for communications.

(5) H.F. equipment.

All the above products involve a relatively high percentage of engineering work. But Israel has an advantage in this field since wages of technical manpower are low there in comparison with other countries.

There is not much room for encouraging the production of components. The latter, of high quality and low prices, can be purchased abroad. Nevertheless, there is room for developing and producing special parts which are not produced in large series abroad either, such as special transistors, independent circuits, special transformers and the like.

When discussing desired directions of development one must take into account that today there is a considerable number of firms which employ altogether some 500 workers and which produce, as circumstances necessitate, entertainment electronic goods which are not very profitable.

A partial solution to the problem may be found in reorganizing the industry in order to allocate and increase output series. But this is only a partial solution which is liable to reduce production costs to a certain extent but will not enable the industry to compete with foreign produced goods.

Nevertheless, the integration of television sets assembly into the organizational framework proposed by the radio manufacturers may increase the profitability of the entire industry's production. If this possibility turns out to be a reality then there will obviously be room for supporting this branch too.

To sum up, it may be said that there are quite a few proposals for furthering the development of the electronics branch in Israel:

(1) Productive capacity must be increased in order to deal with the

subjects mentioned and stressed as desirable ones, in small units of production too.

(2) The types of goods produced should be expanded.

(3) Special loan conditions should be granted for electronics firms since the fixed investment in the branch is very small and, in contrast, the research expenditure is high. A way must be found of recognizing research expenditure as a basic investment (as is the practice regarding know-how) or of recognizing research as a cost of production for purposes of income tax.

(4) The greatest consumer of electronic goods in every country is the defence system. The latter also finances research and development and in the United States, for instance, this finance amounts to 75% of the general expenditure on research in the branch. Since the defence system in Israel has its own electronic establishments it supports mainly internal research which does not help the industry as a whole. Orders for electronic equipment are also given today mainly to establishments of the Defence Ministry. In order to develop the branch it must be integrated into the network of production of the defence system.

(5) A raising of the quality standard should be stressed and goods whose quality is doubtful, should not be allowed to be exported.

(6) The local market should be used for distributing products and experimentation. Various instituions should take upon themselves certain risks (financial losses) in order to facilitate the development of new products. This concerns Kupat Holim (Sick Fund) (medical equipment), schools (educational equipment), the Ministry of Posts (wireless equipment), etc.

(7) A way must be found to activate research institutes (the Weizmann Institute, the Technion) in the direction of more applied research for industry. This research should be financed by the government and industry.

(8) A way must be found to attract experienced foreign companies and especially those with a developed marketing system abroad.

(9) In principle, support must be lent to every serious research which shows that it is capable of working with an industrial approach.

Finally, it can be stated with certainty that possibilities exist for the good integration of Israel into the world electronics industry. Israel has a first-rate manpower with the knowledge necessary for it.

5. The outlook for development in Israel up to 1970:

Table 14: Output and export in the electricity and electronic equipment industry according to main branches, 1964-1970*
(output at 1964 prices in IL million, exports in $1,000)

Branches	1964				1970			
	output	index	exports	index	output	index	exports	index
Electrical motors and transformers	19.5	100	410.00	100	47.4	249	4,100	1,000
Electrical installation and lighting equipment	61.0	100	232.3	100	111.5	183	3,900	1,679
Batteries and accumulators	10.9	100	7.7	100	26.4	242	500	6,493
Domestic electrical appliances	20.7	100	97.6	100	36.9	178	900	922
Radios and gramophones	10.9	100	114.2	100	18.4	169	500	438
Communications instruments and accessories	35.1	100	126.4	100	113.6	320	8,500	6,725
Total	158.4	100	988.2	100	354.2	224	8,400	1,862

* Does not include services, repairs and independent workers.

Concerning the electromechanical branch group, it may be generally said that the development plans needed upto 1970 must be based on existing establishments. This is particularly the case regarding electrical equipment products. In the cable and electric wire branch the trend to replace imports must be intensified and output must be directed to export. The new products whose output is expected to increase are: multi-wire telephone cables up to 2,400 pairs, long distance cables, underground cables with large intersections and unusual lengths, high-tension cables and sub-marine cables.

In the electric boiler branch, it is desirable to merge a number of firms with the aim of reducing production costs, maintaining quality and providing better service.

In the telecommunications branch a considerable expansion is expected both in the local market and foreign markets. In the local market the development plan of the branch should be coordinated with that of the telephone services. The expansion of production for the local market will make it possible to overcome the present problems of exports. Large firms abroad usually export complete series of telecommunications equipment and send skilled manpower to assemble it and provide service. After expansion, local firms will be able to supply these services. Orders for telecommunications equipment should be included in the framework of agreements for technical cooperation with developing countries.

A very considerable expansion is expected in the electronic industry, both in the local and foreign markets. This expansion will be based on the following group of branches:

a. Consumer electronic goods: action to change the structure of the branch must be continued. The concentration of production in one firm will enable the efficient training of workers and an increase in efficiency. It may be assumed that, with the anticipated increase in the local purchase of television sets, there will be a possibility of their local production. Moreover, the first steps have been made in the field of medical equipment production which, due to various problems of commercialization of models constructed in laboratories, has not yet achieved its full potential.

b. Industrial electronic goods: as regards such products as control and measurement apparatus for industry, equipment and laboratories, a considerable development is expected which will be based partly on local know-how and products which have been developed in research institutes and the firms' laboratories. One of the problems to be overcome in this sphere is the commercialization of models which have been produced.

c. Production of electronic instruments: the anticipated development in this field will facilitate the deepening of production and the commencement of large-scale production of components, transistors, cables, transformers, tuners, tubes, loud-speakers, resistors, and so on.

The local firms are showing a considerable amount of development initiative; but in order to develop exports on a large scale there will apparently be a need to attract experienced foreign companies with a developed marketing system abroad.

Large-scale development of the electronics industry will require the presence of high-standard local manpower for the planning of production lines and instruments. Today the supply of high-standard manpower is very limited due to the emigration of good engineers who did not find their place within the limited scope of local firms. In future it will be necessary to increase efforts to attract these forces back to Israel and to expand higher education in this field.

Section II - Method of the Survey's Execution

A. Aims of the Survey

As was stated in the introduction, the survey attempts to find ways of creating closer contacts between vocational training and the electrical and electronic goods industry. In other words, the survey set out to examine to what extent the training received by the vocational education's graduates at the various levels is suited to the needs of this industrial branch. The survey also examines whether the anticipated number of graduates in the near future will meet the requirements for additional manpower in the branch.

Accordingly, the survey set itself six aims:

1. An examination and criticism of the curricula generally to be found in the electricity and electronics trends of vocational schools.
2. An examination of the theoretical and practical knowledge of vocational school graduates in the subjects learnt in the electricity and electronics trends.
3. Hearing the opinions of members of the industry on the quantitative and qualitative changes required to improve instruction in vocational schools. This involves an examination of the deficiencies existing at present and the change which it is desired to introduce in future into the various subjects learnt in the four types of vocational training: short course or two-year vocational school, three-year vocational school, four-year vocational school and senior technical school.
4. A review of the occupations which exist today and which are predicted for the future in electricity and electronics and an examination of the type and duration of training desirable for each occupation.

5. The finding of quantitative relationships between electricians and electronics engineers on the one hand and the rest of the employees in the electricity and electronics branch and other branches employing electricians and electronics technicians on the other hand. Furthermore, a forecast is given for these quantitative relationships and the increase in the numbers of electricians and electronics engineers is predicted.

6. The secondary aims of the survey are: to find out which subjects and qualifications will increase or decrease in importance in the next decade; the desired training for electrical engineers and other employees in positions connected with administration; the extent of dropping-out from electricity and electronics occupations and the reasons for it; machinery and appliances which are in use at present and which will be in use in the future.

B. Definitions and Tasks

In order to provide a proper reply to the basic questions posed by this survey we are obliged to become fully acquainted with the various occupations included in the fields of electricity and electronics; with the tasks of those employed; with the theoretical and practical knowledge required by them in the field of their various occupations and tasks and, above all, with the definitions of the vocations discussed which appear in the literature on the subject.

With the aid of definitions and a maximum knowledge of these occupations and tasks we shall come to a better understanding of the relationship between the vocational training which the graduates of vocational education demand and the requirements of the market. Thus, we shall also be able to express reliable criticism of the curricula of vocational schools. In short, this survey can only be carried out on the basis of definitions and descriptions of these occupations.

1. Definition of the electricity trade:

Planning and production, execution and maintenance in all fields in which electric energy is exploited, starting from the sources of supply and the electrical lines of supply and ending with the variegated needs which consume the energy. (From: Curriculum for Technics and Electricity (proposal) Inter-Departmental Roof Committee on Technics, 1965).

2. Definition of the electronics trade:

The flow of electricity through a vacuum, through gases or through semiconductors (from: Ministry of Labour Survey of Electronics Technicians, the Manpower Planning Authority, 1966); or as defined by the Stanford report:

"Electronics is the science and technology which deal mainly with the means which collect, develop and transfer information in the form of electronic signs. These means control machines or bring the developed information to man for his immediate use".

(From: Stanford Report, 1962)

3. Senior electrician - scope of training and tasks*:

The senior electrician receives a practical, theoretical and laboratory training. Each one has its own methods and aims: the practical training teaches the senior electrician the fundamentals of the use of the various work tools and machines for processing different metals including coloured metals for the needs of the electricity industry. The practical specialization concentrates on basic electrical work (soldering and wiring), repair, production and construction of various electrical instruments as well as installation, maintenance and operation of electrical apparatus including machines and control boards. Experiments in electrical measurements, machines and installations and in electronics are held in the framework of the laboratory training which the senior electrician receives.

The theoretical training includes, apart from the usual study of the humanities, basic scientific subjects (mathematics, physics, chemistry) and general subjects (industrial organization, costing and safety), general technical subjects (technical drawing and theoretical engineering, mechanical technology,

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[*] According to Curriculum for Technics and Electricity (proposal), Inter-Departmental Roof Committee on Technics, 1965)

mechanics, strength of materials, details of machines, thermodynamics and thermal machines) and technical subjects of specialization (electricity theory, electrical drawing and schematics, materials and electrical installations, electrical measurements, electrical machinery, motion-regulation-control, the electrical goods and appliances industry, electronics and practical electronics).

This theoretical and practical knowledge which is acquired through practice, in laboratory or theoretically, enables the senior electrician to carry out independently maintenance work, operation, installation, repairs, assembly and tests of electrical equipment and installations according to blue-prints or instructions, taking into consideration the safety regulations and in accordance with fixed and accepted work processes laid down by the Israeli standard.

The senior electrician must be able to serve as the assistant of an electrical engineer in the fields of planning and supervision and to fulfull planning and supervisory tasks independently in keeping with his education. The theoretical, laboratory and practical training enables him to keep track of the rapid rate of innovation in the various fields of the electricity industry.

In accordance with the training of various types, the senior electrician's tasks may be summarized in the following six spheres:

A. Maintenance

(1) Administration and organization of electrical maintenance in various user installations.

(2) Current test of electrical equipment and installations; design of parts and order of instruments and equipment for purposes of current maintenance.

(3) Localization of faults and preventive treatment; planning, management and execution of repairs.

(4) Supervision of maintenance work and instruction of electricians in the operation of new equipment.

B. Installation

(1) Transfer of data on installations received from high level planning to blueprints; assistance in general planning of complex installations.

(2) Preparation of installation plans (at suitable extent) and formulation of plans for working drawings.

(3) Independent planning and execution of electrical installations (at appropriate level).

(4) Preparation of tenders and technical specifications.

(5) Supervision of execution and guidance of workers in the installation of electrical apparatus.

C. Testing

(1) Laboratory tests to determine the quality of an instrument or product and test of electrical installations.

(2) Special tests in research institutes and electrical laboratories, in accordance with the Electricity Law.

D. Production

(1) Drawing up of production plans (at appropriate level) and organization of production processes.

(2) Planning and execution of prototypes and models (at appropriate level).

(3) Choice of suitable materials for the product.

(4) Supervision of production work in the electricity industry.

E. Sales and Commerce

(1) Administration and organization of sales companies for selling and trading in products of the electricity industry.

(2) Technical representation in the marketing of products of the electricity industry.

(3) Penetration of new products into the market and guidance of operators in the use of new equipment.

(4) Data processing and preparation of catalogues.

F. Instruction and Guidance

(1) Theoretical instruction in technical subjects of specialization in the electrochemical field in technical schools (at levels of instruction suitable to the theoretical education and practical training received).

(2) Vocational instruction in technical schools in the execution of practical work in the fields of electrical maintenance, installation and production.

(3) Laboratory instruction in technical schools in carrying out experiments in measurements, installations and electrical machinery.

(4) Coordination and administration of vocational and laboratory instructions in technical schools.

4. The electronics technician - his tasks and the training required for them*:

The task of the electronics technician is defined as a combination of occupations in the classification of electronic occupations (the classification was prepared by a manpower committee of the Communications and Electronics Council).

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* From: Electronic Manpower Research, the Ministry of Labour, 1966.

With regard to at least part of the task's occupations, a formal training in electronics is required. Seniority and advancement in work may serve as a substitute for formal training.

Table 15: List of principal occupations in electronics according to their professional level

Occupation serial no.	Name and definition of occupation	Occupational level			
		Academic	Senior technical	Skilled	Partly skilled
1.	Research and Development Discovery of application of scientific innovation and principles.	+			
2.	Systems engineering Design of various combinations of electronic equipment for use in given conditions, forecast and calculation of conduct of equipment in given conditions.	+	+		
3.	Circuit development and design Discovery of uses for existing circuits; choice and calculation of principal circuit; choice of components and calculation of their values; summary of specifications; carrying out of measurements.	+	+		

(Table continued on next page)

Occupation serial no.	Name and definition of occupation	Occupational level			
		Academic	Senior technical	Skilled	Partly skilled
4.	Technical training Preparation of curriculum and further education courses; lectures according to a given program; demonstration and exercise of material learnt; (use of teaching aids and instructional assessories); holding of examinations.	+	+		
5.	Preparation of standards and their specifications Preparation of standards or specifications for equipment, circuits or components	+	+		
6.	Layout of components Determination of components' place in a given circuit, taking account of the mechanical and electrical data.	+	+		
7.	Experimentation and measurement Determination of measurement series; choice of dimensions (measuring instruments); editing of calculations and reports.	+	+		

(Table continued on next page)

Occupation serial no.	Name and definition of occupation	Occupational level			
		Academic	Senior technical	Skilled	Partly skilled
8.	Product design Determination of the physical form of the product; choice of materials suitable for its production taking into account the principles of human engineering; production processes with attention to aesthetic appearance.	+	+		
9.	Preparation of testing instructions Determiantion of testing methods and drawing-up of testing instructions in order to ascertain that the equipment fulfills the requirements of the specifications.	+	+		
10.	Estimate of labour and materials Analysis of labour and estimate of work hours to be invested in materials necessary for development, production, maintenance and installation of equipment.	+	+		
11.	Preparation of production file Preparation of production documents such as production guidelines, blueprints, lists of components and raw materials.	+	+		

(Table continued on next page)

Occupation serial no.	Name and definition of occupation	Occupational level			
		Academic	Senior technical	Skilled	Partly skilled
12.	Localization and repair of faults Diagnosis, analysis and repair of faults.		+	+	
13.	Writing of technical literature Editing and formulation of technical publications such as handbooks, maintenance instructions etc.		+		
14.	Guidance at work Demonstration, explanation and exercise of workers in work processes and supervision of execution.		+	+	
15.	Installation of systems and auxiliary equipment Choice of place for installation; localization and fixing of systems, equipment and auxiliary equipment; trial and operation of apparatus.		+	+	
16.	Calibration and adjustment Calibration of instruments in laboratory using standard measuring instruments; adjustment of instruments or systems in preparation for operation or periodic examination.		+	+	

(Table continued on next page)

Occupation serial no.	Name and definition of occupation	Occupation level			
		Academic	Senior technical	Skilled	Partly skilled
17.	Electrical testing Examination of equipment's technical data according to standards and specifications with measuring instruments and specific apparatus.			+	
18.	Mechanical testing Measurement or verification of measurements, materials quality, quality of work and finish, test of their compliance with standards and specifications; use of guages, measuring tools and specific apparatus.			+	+
19.	Suitability test Suitability control of equipment being installed or in the course of preventive maintenance in order to ascertain if the execution of the skilled worker is in accordance with the required quality.			+	+
20.	Cable welding Laying of underground or overhead cables, their connection and repair.			+	+
21.	Lines Suspension of overhead lines, their connection and repair.			+	+

(Table continued on next page)

Occupation serial no.	Name and definition of occupation	Occupational level			
		Academic	Senior technical	Skilled	Partly skilled
22.	Chemical preparation Electrolytic corrosion of material, preparation of solutions according to written prescriptions whilst observing a fixed time for the action or a standard temperature in the apparatus.			+	+
23.	Preparation of crystals and semi-conductors Processing, polishing, sawing, examination of thickness and mechanization of semi-conductors and crystals with mechanical and optical equipment.			+	+
24.	Coil-winding Winding of electric wires on reels by hand machine or automatic machine				+
25.	Welding and soldering of miniature components Connection of metal parts or parts of semi-conductive material, by spot welding, immersion in tank or by means of soldering apparatus using soldering tweezers, small welding equipment and complex specific equipment.				+

(Table continued on next page)

Occupation serial no.	Name and definition of occupation	Occupational level			
		Academic	Senior technical	Skilled	Partly skilled
26.	Assembly of miniature components Care of miniature parts, placement of contacts and parts using a microscope or other complex specific equipment.				+
27.	Wiring Arrangement of wires on contacts boards, their connection, strengthening, formation into plaits, cutting according to measure and exposure of insulation according to a plan.				+
28.	Assembly Assembly of instruments or units from parts, tightening of screws, rivetting, glueing and tying according to plan or instructions with the aid of simple tools.				+
29.	Soldering Connection of wires or components to terminals of a chassis or printed circuit according to plan with the aid of special tools.				+
30.	Cleaning Cleaning of instruments or sub-units of equipment by mechanical or chemical means; work according to instructions and under supervision.				+

(Table continued on next page)

Occupation serial no.	Name and definition of occupation	Occupational level			
		Academic	Senior technical	Skilled	Partly skilled
31.	Servicing of communications and electronic equipment Regulation, adjustment and maintenance of instruments in accordance with instructions; reading of indicators and submission of reports on deficiencies.	+	+	+	+

C. The sample

There are approximately 60 establishments with over 30 employees in the electricity and electronics industry. These 60 establishments are divided into the following seven sub-branches:

1. Electric motor and transformer industry.
2. Electrical installation and lighting equipment industry.
3. Battery and accumulator industry.
4. Domestic electrical appliance, air-conditioner, elevator, washing machine, etc. industry.
5. Radio, television and gramophone industry.
6. Communications instruments and accessories industry.
7. Production and repair of electronic instruments for science and medicine.

A random sample of nine firms was taken from the above seven sub-branches whilst ensuring that each sub-branch was represented.

Also included were a number of branches which were not directly engaged in electricity and electronics but which maintained a team of electricians and electronics technicians. These branches are:

1. Research.
2. Tyres, inner-tubes and belts.
3. Asbestos pipes and boards.
4. Metal pipes.
5. Petroleum products.
6. Thread, cloth, ready-made clothing.
7. Operation and maintenance of the electricity network.
8. Food manufacture.
9. Rails transportation.
10. Post Office.
11. Israel Defence Forces; Ministry of Defence.

D. Description of tools.

All the information needed by us for the purposes of this survey was collected by means of a special questionnaire (see appendix). Interviews were sent to the firms included in the sample in order to deliver the questionnaires. Engineers and manpower personnel familiar with the problems of manpower absorption and with the firms' needs for the various occupations were interviewed.

The main variables of the questionnaire were:

1. The various occupations existing in electricity and electronics.

2. Subjects and qualifications learnt in the electricity and electronics trends.

3. Duration and type of training given to electricians and electronics technicians.
4. The number of graduates of vocational schools working at present and predicted in future.

Other variables were also examined such as the machines and instruments with which it is desirable to train the graduates to work, the desired training for electrical engineers, the amount of dropping-out from the vocation, etc.

The interviewers were given a detailed list of the occupations in electricity and electronics and their definitions. A detailed and graduated explanation was also given of the material learnt in the various subjects at vocational schools.

The interviewers were requested to give marks to the vocational school graduates according to the level of their knowledge in the various subjects learnt (see table 16). They were also requested to indicate what the future requirements would be for the workers in the various occupations.

Table 16: Marks given in questionnaire

PRESENT		FUTURE	
Excellent	A	Large reduction	i
Good	B	Slight reduction	ii
Satisfactory	C	No change	iii
Slightly deficient	D	Slight increase	iv
Very deficient	E	Large increase	v

Section III - Findings of the Survey

A. The present situation of the graduates at the different levels

1. Graduates of vocational courses (including two-year vocational schools)

Table 17: Distribution of vocational courses graduates according to the marks given on their present situation in general subjects (percentages)

General Subjects		Marks on present situation				
		Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Hebrew	Oral expression	0	6	11	83	0
	Written expression	0	3	10	4	83
Technical English	Oral expression	0	3	83	11	3
	Written expression	0	3	83	11	3
Mathematics		0	0	3	95	2
Physics		0	0	95	3	2
Chemistry		0	0	95	3	2
Technical drawing	Reading and understanding	0	0	90	9	1
	Knowledge of drawing	0	1	97	1	1

(Table continued on next page)

General Subjects	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Commerce, costing, technical reporting					
Computers, theory and programming	0	0	0	1	0
Psychology of human relationships	0	0	0	0	1
Sociology and industrial management	0	0	0	0	1
Safety and hygiene	0	1	4	95	0
Visits to industry and workshop practice	0	0	99	1	0

Maximum number of workers (100%): 1129.

The very poor situation of the vocational course graduates in Hebrew-written expression- is outstanding in this table. The situation of oral expression is still deficient too, even though less than that of written expression. The situation in mathematics and safety and hygiene is slightly deficient. In the remaining subjects, i.e., the majority, the situation is satisfactory.

Table 18: Distribution of vocational course graduates according to the marks given on the present situation of their qualifications (percentage)

Qualifications	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Self-learning capability	0	0	95	5	0
Capability to adjust to changes	0	0	90	10	0
Thinking in economic terms	0	0	2	2	1
Pride in manual labour	0	94	5	1	0
Team work	1	92	6	1	0
Efficiency conscionsness	1	10	3	3	0
Quality consciousness	0	0	90	2	0
Responsibility	1	7	90	2	0
Agility	1	93	4	2	0
Precision	0	2	96	2	0
Special imagination	0	0	2	2	0

Maximum number of workers (100%): 1,154.

The present situation of the graduates of two-year vocational schools and vocational courses as far as the various qualifications are concerned is satisfactory and even good. The good situation regarding manual labour, team work and agility is particularly outstanding.

Table 19: Distribution of vocational course graduates according to the marks given on their present situation in electricity (percentage)

Electricity	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Technology and mechanics	0	5	55	30	10
Strength of materials and machine details	0	0	63	15	13
Engineering and heat	0	0	63	16	5
Electricity theory	0	10	58	29	0
Materials and installations	0	0	63	36	0
Electrical measurement	0	0	63	23	13
Electrical machines	0	12	57	26	0
Motion, regulation, control	0	10	8	30	0
Electrical goods industry	0	3	47	10	6
Industrial electronics	0	0	0	0	100
Electromechanical workshop	0	13	68	10	0
Measurement laboratory and apparatus	0	0	47	15	0
Machine laboratory	0	0	47	15	0
Electronics laboratory	0	0	0	0	100
Projects					
Mechanical workship					

Maximum number of workers (100%): 171.

The present situation in electricity in two-year vocational schools and vocational courses is generally satisfactory. Particular mention should be made of the situation in industrial electronics and the electronics laboratory, where the situation is most deficient (the situation of 100% of the pupils in these trends is very deficient) and was the subject of much comment and alarm on the part of the interviewers.

Table 20: Distribution of vocational course graduates according to the marks given on their present situation in electronics (percentages)

Electronics	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Electricity and network theory	0	0	90	1	9
General electronics	0	0	52	0	48
Measurement	0	0	100	0	0
Electrical machines	0	0	97	3	0
Reception and transmission	0	3	0	0	0
Industrial electronics	0	8	0	3	24
Practical work and laboratories	0	8	3	0	24
V.H.F.	0	0	0	3	0
Television	0	0	0	0	3
Communications and communications apparatus	0	0	0	8	3
Automation and telemechanics	0	0	0	0	3
Constructions and production	0	0	0	0	3
Components	0	0	0	0	8

Maximum number of workers (100%): 109.

The table shows that the present situation of short vocational courses is generally satisfactory as regards electronics subjects. The exceptions are general electronics, industrial electronics and practical work and laboratories. The situation of these subjects is most deficient.

2. Graduates of three-year vocational schools

Table 21: Distribution of three-year school graduates according to the marks given on their present situation in general subjects (percentages)

General Subjects		Marks on present situation				
		Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Hebrew	Oral expression	0	37	63	0	0
	Written expression	0	38	51	11	0
Technical English	Oral expression	0	0	2	81	11
	Written expression	0	0	51	38	11
Mathematics		0	0	32	68	0
Physics		0	0	54	20	0
Chemistry		0	0	75	25	0
Technical drawing	Reading and understanding	0	6	83	11	0
	Knowledge of drawing	8	4	38	4	0

(Table continued on next page)

General Subjects	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Commerce, costing, technical reporting	0	0	1	0	0
Computers, theory and programming	0	0	0	80	0
Psychology of human relationships	0	0	20	50	0
Sociology and industrial management					
Safety and hygiene	0	1	85	5	0
Visits to industry and workshop practice	0	0	80	0	0

Maximum number of workers (100%): 761.

The present situation of the three-year vocational school graduates is satisfactory and even good in Hebrew (oral and written expression). The situation in technical English - oral expression - is slightly deficient. The situation is also slightly deficient in mathematics, computers and psychology of human relationships. The situation is satisfactory in English - written expression, apparently because written expression in English was not required of the graduates. The situation is also satisfactory in physics, chemistry, drawing, safety and hygiene and visits to industry and workshop practice.

Table 22: Distribution of three-year school graduates according to the marks given on the present situation of their qualifications (percentages)

Qualifications	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Self-learning capability	0	0.5	99	0	0
Capability to adjust to changes	0	50	50	0	0
Thinking in economic terms	0	0	11	0	0
Pride in manual labour	0.5	0	62	0	0
Team work	0	20	78	0	0
Efficiency consciousness	0	66	31	0	0
Quality consciousness	0	2	85	7	0
Responsibility	0	2	96	2	0
Agility	0	2	96	0	0
Precision	0	20	78	0	0
Special imagination	0	17	55	0	18

Maximum number of workers (100%): 759.

The present situation of the three-year vocational school graduates' various qualifications is generally satisfactory. Their situation regarding capability to adjust to changes and efficiency consciousness is good.

Table 23: Distribution of three-year school graduates according to the marks given on their present situation in electricity (percentages)

Electricity	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Technology and mechanics	0	1	36	14	18
Strength of materials and machine details	0	1	45	7	18
Engineering and heat	0	2	50	2	18
Electricity theory	0	15	60	25	0
Materials and installations	2	0	70	8	0
Electrical measurement	0	3	19	50	1
Electrical machines	0	15	55	8	0
Motion, regulation, control	0	15	3	55	7
Electrical goods industry	0	0	25	1	0
Electromechanical workshop	0	0	55	19	8
Measurement laboratory and apparatus	0	0	23	8	33
Machine laboratory	0	0	6	1	33
Electronics laboratory	0	0	7	7	1
Projects	0	0	23	0	0
Mechanical workshop					

Maximum number of workers (100%): 171.

The present situation of the three-year vocational school graduates is generally satisfactory in electricity. The situation is slightly deficient in measurement of electricity, motion-regulation-control and the various types of laboratories.

Table 24: Distribution of three-year school graduates according to the marks given on their present situation in electronics (percentages)

Electronics	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Electricity and network theory	0	0	85	0	13
General electronics	3	0	20	12	2
Measurement	3	13	18	12	51
Electrical machines	0	3	82	0	12
Reception and transmission	0	3	0	25	0
Industrial electronics	3	0	0	13	13
Practical work and laboratories	3	0	13	12	2
V.H.F.	0	0	3	13	0
Television	0	0	3	15	0
Communications and communications apparatus	0	3	51	13	0
Automation and telemechanics	0	16	55	0	12
Constructions and production	0	3	13	0	0

Maximum number of workers (100%): 110.

The present situation of the three-year vocational school graduates in electronics is generally satisfactory except for measurement - where the situation is very deficient - and reception and transmission where the situation is slightly deficient.

3. Graduates of four-year vocational schools

Table 25: Distribution of four-year school graduates according to the marks given on their present situation in general subjects (percentages)

General Subjects		Marks on present situation				
		Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Hebrew	Oral expression	0	36	64	0	0
	Written expression	0	38	29	0	0
Technical English	Oral expression	0	0	28	36	34
	Written expression	0	0	16	83	1
Mathematics		35	16	38	0	0
Physics		0	56	38	0	0
Chemistry		0	0	93		0
Technical drawing, descriptive geometry electrical design, schematics	Reading and understanding	0	0	39	55	0
	Knowledge of drawing	0	5	34	55	1

(Table continued on next page)

General Subjects	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Commerce, costing, technical, reporting	0	0	38	0	16
Computers, theory and programming	0	0	3	32	0
Psychology of human relationships	0	0	3	32	0
Sociology and industrial management	0	0	0	3	0
Safety and hygiene	0	0	32	65	0
Visits to industry and workshop practice	0	0	32	17	0

Maximum number of workers (100%): 156.

The present situation of four-year vocational schools is slightly deficient in English (oral and written), drawing, computers, psychology of human relationships and safety and hygiene. The situation is generally satisfactory in the rest of the subjects and even good in Hebrew, mathematics and physics.

Table 26: Distribution of four-year school graduates according to the present situation of their qualifications (percentages)

Qualifications	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Self-learning capability	0	33	28	6	33
Capability to adjust to changes	0	33	30	37	0
Thinking in economic terms	0	0	0	5	1
Pride in manual labour	0	0	45	0	0
Team work	0	0	15	23	0
Efficiency consciousness	0	15	33	11	31
Quality consciousness	0	35	29	5	0
Responsibility	0	35	40	5	0
Agility	0	24	40	0	0
Precision	0	54	7	38	0
Special imagination	34	0	6	5	23

Maximum number of workers (100%): 156.

The opinions of the industry's members were divided on the present situation of the various qualifications of four-year vocational school graduates. A number of them claim that the situation is good and even excellent (special imagination) whereas others claim that the position is deficient (in efficiency consciousness, self-learning capability and special imagination). All agree that the situation is satisfactory as regards pride in manual labour, quality consciousness, responsibility and agility.

Table 27: Distribution of four-year school graduates according to the marks given on their present situation in electricity (percentages)

Electricity	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Technology and mechanics	0	3	21	11	0
Strength of materials and machine details	0	3	21	11	0
Engineering and heat	0	0	30	0	0
Theory of electricity	0	3	42	32	0
Materials and installations	0	2	50	18	0
Electrical measurement	0	3	53	20	0
Electrical machines	0	18	43	27	0
Motion, regulation, control	0	3	37	8	3
Electrical goods industry	0	0	0	8	0
Industrial electronics	0	0	13	4	0
Electromechanical workshop	0	2	66	32	0
Measurement laboratory and apparatus	0	0	24	18	0
Machine laboratory	0	0	0	24	0
Electronics laboratory	0	0	0	11	0
Projects	0	0	0	0	0
Mechanical workshop	0	0	0	13	0

Maximum number of workers (100%): 250.

Table 27 shows that the present situation of the graduates of four-year vocational schools in electricity is generally satisfactory.

Table 28: Distribution of four-year school graduates according to the marks given on their present situation in electronics (percentages)

	Marks on present situation				
Electronics	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Electricity and network theory	11	7	18	62	2
General electronics	0	7	22	70	0
Measurements	0	1	60	38	0
Electrical machines	0	0	73	8	2
Reception and transmission	0	1	38	20	8
Industrial electronics	0	0	32	45	10
Practical work and laboratories	0	7	28	50	0
V.H.F.	0	0	13	36	0
Television	0	0	11	36	8
Communications and communications and apparatus	10	0	0	78	0
Automation and telemechanics	0	0	25	43	2
Constructions and production	0	0	13	0	0
Components	0	0	0	7	0

Maximum number of workers (100%): 499.

The present situation of four-year vocational school graduates in electronics is slightly deficient. Particularly outstanding is the deficiency in electricity and network theory, general electronics, industrial electronics, practical work and laboratories, V.H.F., television, communications and communications apparatus and automation and telemechanics.

4. Graduates of senior technical schools

Table 29: Distribution of senior technical school graduates according to the marks given on their present situation in general subjects (percentages)

General Subjects		Marks on present situation				
		Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Hebrew	Oral expression	2	45	20	0	0
	Written expression	2	20	30	0	0
Technical English	Oral expression	0	21	17	16	12
	Written expression	0	0	17	13	8
Mathematics		0	40	54	5	0
Physics		0	40	54	3	4
Chemistry		0	30	5	3	0
Technical drawing, descriptive geometry, electrical design, schematics	Reading and understanding	21	2	17	5	0
	Knowledge of drawing	24	17	21	3	0

(Table continued on next page)

General Subjects	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Commerce, costing technical reporting	0	0	0	0	21
Computers, theory and programming	0	0	2	0	8
Psychology of human relationships	0	0	0	0	0
Sociology and industrial management					
Safety and hygiene	0	30	3	8	0
Visits to industry and workshop practice	0	0	0	10	0

Maximum number of workers (100%): 76.

The present situation of the senior technicians in general subjects is good and even excellent. There is a deficiency in commerce, costing and technical reporting. Particularly worthy of mention is their knowledge of technical drawing which is excellent in the opinion of all the interviewees.

Table 30: Distribution of senior technical school graduates according to the marks given on the present situation of their qualifications (percentages)

Qualifications	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Self-learning capability	32	36	26	6	0
Capability to adjust to changes	0	56	12	6	0
Thinking in economic terms	0	0	6	32	2
Pride in manual labour	0	32	4	2	0
Team work	0	32	4	14	0
Efficiency consciousness	0	32	6	2	0
Quality consciousness	0	34	0	4	0
Responsibility	0	52	38	0	0
Agility	0	36	20	0	0
Precision	2	50	50	0	0
Special imagination	0	32	12	0	0

Maximum number of workers (100%): 51.

The present situation of the various qualifications of the senior technicians is good, except for thinking in economic terms in which the situation is slightly deficient. It should be pointed out that 32% of the interviewees assessed the senior technicians' self-learning capability as excellent.

Table 31: Distribution of senior technical school graduates according to the marks given on their present situation in electricity (percentages)

Electricity	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Technology and mechanics	0	0	3	0	30
Strength of materials and machine details	0	28	3	2	0
Engineering and heat	23	0	3	10	0
Electricity theory	28	53	18	3	0
Materials and installations	5	28	15	0	0
Electrical measurement	0	15	80	3	0
Electrical machines	0	33	50	2	0
Motion, regulation, control	0	0	7	80	0
Electrical goods industry	0	23	50	0	0
Industrial electronics	0	5	5	80	0
Electromechanical workshop	0	0	3	28	0
Measurement laboratory and apparatus	0	0	2	28	3
Machine laboratory	0	0	0	28	3
Electronics laboratory	0	0	2	5	0
Projects					
Mechanical workshop					

Maximum number of workers (100%): 62.

The present situation of senior technical school graduates in electricity is good and even excellent. 23%-28% of the interviewees noted that the situation was excellent in engineering and heat and in electricity theory. The situation is slightly deficient in motion-regulation - control and in industrial electronics. The situation is very deficient in technology and mechanics.

Table 32: Distribution of senior technical school graduates according to the marks given on their present situation in electronics (percentages)

Electronics	Marks on present situation				
	Excellent A	Good B	Satisfactory C	Slightly deficient D	Very deficient E
Electricity and network theory	0	58	24	16	0
General electronics	0	58	6	16	0
Measurements	0	46	16	0	4
Electrical machines	0	34	4	0	0
Reception and transmission	0	2		0	0
Industrial electronics	0	24	6	50	0
Practical work and laboratories	34	32	16	0	0
V.H.F.	0	0	2	0	24
Television	0	0	0	0	36
Communications and communications and apparatus	0	0	4	0	0
Automation and telemechanics	0	34	4	48	0
Constructions and production	0	0	0	2	0
Components					
General chemistry	0	0	2	0	0

Maximum number of workers (100%): 49.

The present situation of senior technical school graduates in electronics is good. In practical work and laboratories the situation is excellent and in industrial electronics, automation and telemechanics it is slightly deficient. It is very deficient in V.H.F. and television.

B. The predicted future situation of the graduates at the different levels

1. Vocational course (including two-year vocational school) graduates

Table 33: Predicted distribution of vocational course graduates according to the marks given to future requirements for general subjects (percentages)

General Subjects		Marks given to future needs				
		Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Hebrew	Oral expression	0	0	95	5	0
	Written expression	0	0	95	5	0
Technical English	Oral expression	0	0	86	0	8
	Written expression	0	0	84	2	8
Mathematics		0	0	86	0	0
Physics		0	0	86	0	0
Chemistry		0	0	86	0	0
Technical drawing	Reading and understanding	0	0	86	4	0
	Knowledge of drawing	0	0	11	0	0

(Table continued on next page)

General Subjects	Marks given to future needs Large reduction i	 Slight reduction ii	 No change iii	 Slight increase iv	 Large increase v
Commerce, costing, technical reporting	0	0	0	0	0
Computers, theory and programming	0	0	0	2	0
Psychology of human relationships	0	0	0	0	0
Sociology and industrial management	0	0	0	0	2
Safety and hygiene	0	0	0	91	0
Visits to industry and workshop practice	0	0	84	2	0

Maximum number of workers (100%): 298.

The number of workers graduating from two-year vocational schools that will be needed in future is smaller than the present number: 298 in comparison with 1,129.

There will be no need in future to change the level or form of study in most of the general subjects which are taught in the two-year vocational schools or at vocational courses. The only subject whose study was reported as being in need of increase was safety and hygiene.

Table 34: Predicted distribution of vocational course graduates according to the marks given to future requirements for qualifications (percentages)

Qualifications	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Self-learning capability	0	0	0	9	0
Capability to adjust to changes	0	0	91	9	0
Thinking in economic terms	0	0	0	6	0
Pride in manual labour	0	0	0	96	0
Team work	0	0	91	9	0
Efficiency consciousness	0	0	91	9	0
Quality consciousness	0	0	91	9	0
Responsibility	0	0	91	9	0
Agility	2	0	91	9	0
Precision	0	0	91	9	0
Special imagination	0	0	0	9	0

Maximum number of workers (100%): 274.

The number of workers graduating from two-year vocational schools that will be required in future is less than the present number: 274 as compared with 1,154.

There is no need to change the present situation in the development of the various qualifications in two-year vocational schools or vocational courses. However, some 96% of the interviewees are of the opinion that development of a pride in manual labour should be increased.

Table 35: Predicted distribution of vocational course graduates according to the marks given to future requirements for electricity (percentages)

Electricity	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Technology and mechanics	0	0	0	100	0
Strength of materials and machine details	0	0	66	0	0
Engineering and heat	0	0	66	0	0
Electricity theory	0	0	66	0	33
Materials and installations	0	0	0	66	22
Electrical measurement	0	0	0	66	11
Electrical machines	0	0	0	66	11
Motion, regulation, control	0	0	0	0	66
Electrical goods industry					
Industrial electronics					
Electromechanical workshop	0	0	0	90	0
Measurement laboratory and apparatus					
Machine laboratory					
Electronics laboratory					
Projects					
Mechanical workshop					

Maximum number of workers (100%): 36.

The required number of workers graduating from two-year vocational schools in future is less than their present number: 36 as compared with 171.

It is desirable to increase slightly the study of the following subjects in two-year vocational schools or vocational courses: technology and mechanics, materials and installations, electrical measurement, electrical machines and electro-mechanical workshop. A considerable increase is desirable in motion-regulation-control. No change is required in the present situation of the remaining subjects.

Table 36: Predicted distribution of vocational course graduates according to the marks given to future requirements for electronics (percentages)

Electronics	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Electricity and network theory	0	0	100	0	0
General electronics	0	0	0	100	0
Measurement	0	0	75	25	0
Electrical machines	0	0	75	0	0
Reception and transmission					
Industrial electronics	0	0	25	0	0
Practical work and laboratories	0	0	25	0	0
V.H.F.					
Television					
Communications and communications apparatus					
Automation and telemechanics	0	0	0	0	25
Constructions and production					
Components	0	0	0	0	25

Maximum number of workers (100%): 32.

The number of workers who are graduates of two-year vocational schools which will be required in future is less than the number at present: 32 as compared to 109.

The main future demand in electronics in two-year vocational schools or vocational courses is to increase slightly the study of general electronics. No change is required in the present situation of the remaining subjects.

2. Three-year vocational school graduates:

Table 37: Predicted distribution of three-year school graduates according to the marks given to future requirements for general subjects (percentages)

General Subjects		Marks given to future needs				
		Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Hebrew	Oral expression	0	0	17	81	1
	Written expression	0	0	17	81	1
Technical English	Oral expression	0	0	85	6	6
	Written expression	0	0	90	1	6
Mathematics		0	0	17	80	4
Physics		0	0	96	0	4
Chemistry		0	0	7	4	4
Technical drawing	Reading and understanding	0	0	85	10	4
	Knowledge of drawing	0	0	90	2	4

(Table continued on next page)

General Subjects	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Commerce, costing, technical reporting	0	0	0	1	0
Computers, theory and programming	0	0	0	3	0
Psychology of human relationships					
Sociology and industrial management	0	0	4	0	0
Safety and hygiene	0	0	80	10	0
Visits to industry and workshop practice	0	0	90	1	0

Maximum number of workers (100%): 1,895.

The number of workers required in future is greater than at present: 1,895 as compared with 761.

Study of Hebrew (oral and written expression) and mathematics in three-year vocational schools should be slightly increased. As regards the other subjects, there is no need for a change in the present situation.

Table 38: Predicted distribution of three-year school graduates according to the marks given to future requirements for qualifications (percentages)

Qualifications	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Self-learning capability	0	0	85	7	1
Capability to adjust to changes	0	0	85	12	1
Thinking in economic terms	0	0	4	0	1
Pride in manual labour	0	0	98	0	1
Team work	0	0	18	80	1
Efficiency consciousness	0	0	45	0	1
Quality consciousness	0	0	4	84	1
Responsibility	0	0	8	6	1
Agility	0	0	98	0	1
Precision	0	0	98	1	1
Special imagination	0	0	3	2	0

Maximum number of workers (100%): 1,895.

The number of workers required in future is greater than at present: 1,895 as compared with 759.

Quality consciousness and team work should be intensified in three-year vocational schools. There is no need to change the situation regarding the fostering of the remaining qualifications.

Table 39: Predicted distribution of three-year school graduates according to the marks given to future requirements for electricity (percentages)

Electricity	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Technology and mechanics	0	0	0	54	0
Strength of materials and machine details	0	0	0	54	0
Engineering and heat	0	0	2	54	2
Electricity theory	0	0	5	54	39
Materials and installations	0	0	4	54	39
Electrical measurement	0	0	2	39	50
Electrical machines	0	0	8	54	2
Motion, regulation, control	0	0	2	0	27
Electrical goods industry	0	0	8	39	0
Industrial electronics	0	0	8	0	19
Electromechanical workshop	0	0	41	19	8
Measurement laboratory and apparatus	0	0	0	2	19
Machine laboratory	0	0	39	2	19
Electronics laboratory	0	0	2	0	2
Projects	0	0	2	0	6
Mechanical workshop					

Maximum number of workers (100%): 260.

The number of workers required in future is greater than the present number: 260 as compared with 171.

Increased study of most electricity subjects is needed in the three-year vocational schools. In particular, a considerable intensification of study is required in electrical measurement and motion-regulation-control; a slight increase is needed in: technology and mechanics, strength of materials and machine details, engineering and heat, electricity theory, materials and installations, electrical machines and the electrical goods industry.

Table 40: Predicted distribution of three-year school graduates according to the marks given to future requirements for electronics (percentages)

Electronics	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Electricity and network theory	0	0	51	18	30
General electronics	0	0	2	14	0
Measurement	0	0	11	40	18
Electrical machines	0	0	48	18	0
Reception and transmission	0	0	0	11	0
Industrial electronics	0	0	3	11	0
Practical work and laboratories	0	0	14	0	0
V.H.F.	0	0	11	0	0
Television	0	0	11	0	0
Communications and communications apparatus	0	0	18	11	0
Automation and telemechanics	0	0	14	18	3
Constructions and productions	0	0	11	0	0
Components	0	0	0	0	3

Maximum number of workers (100%): 267.

The number of workers required in future is greater than that at present: 267 as compared with 110.

The study of the following subjects should be increased slightly in three-year vocational schools: general electronics, measurement, automation and telemechanics. No change is required in the other subjects.

3. Four-year vocational school graduates:

Table 41: Predicted distribution of four-year school graduates according to the marks given to future requirements for general subjects (percentages)

General Subjects		Marks given to future needs				
		Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Hebrew	Oral expression	0	0	55	45	0
	Written expression	0	0	55	45	0
Technical English	Oral expression	0	0	15	43	27
	Written expression	0	0	74	21	2
Mathematics		0	0	79	16	0
Physics		0	0	87	8	0
Chemistry		0	1	94		0
Technical drawing, descriptive geometry, electrical drawing, schematics	Reading and understanding	0	0	75	20	2
	Knowledge of drawing	0	13	38	2	0

(Table continued on next page)

General Subjects	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Commerce, costing, technical reporting	0	0	8	10	2
Computers, theory and programming	0	0	44	47	0
Psychology of human relationships	0	0	0	56	0
Sociology and industrial management	0	0	0	0	0
Safety and hygiene	0	0	80	5	0
Visits to industry and workshop practice	0	0	93	0	2

Maximum number of workers (100%): 1,901.

The number of workers required in future is larger than that at present: 1901 as compared with 156.

In four-year vocational schools there is a need for a slight increase in the study of: Hebrew and English (oral and written expression), commerce-costing-technical reporting, computers and psychology of human relationships. There is no need for a change in the situation of the remaining subjects.

Table 42: Predicted distribution of four-year school graduates according to the marks given to future requirements for qualifications (percentages)

Qualifications	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Self-learning capability	0	0	10	90	
Capability to adjust to changes	0	0	5	48	0
Thinking in economic terms	0	0	1	14	1
Pride in manual labour	0	0	50	2	0
Team work	0	0	97	3	0
Efficiency consciousness	0	0	95	3	0
Quality consciousness	0	0	72	26	0
Responsibility	0	0	22	78	0
Agility	0	0	90	3	0
Precision	0	0	84	13	0
Special imagination	0	0	25	47	26

Maximum number of workers (100%): 1,867.

The number of workers required in future is greater than at present: 1,867 as compared to 156.

A slight increase is required in the four-year vocational schools in: self-learning capability, capability to adjust to changes, responsibility and special imagination. No change is required in the present fostering of other qualifications.

Table 43: Predicted distribution of four-year school graduates according to the marks given to future requirements for electricity (percentages)

Electricity	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Technology and mechanics	0	0	35	16	6
Strength of materials and machine details	0	0	39	10	4
Engineering and heat	0	23	16	7	5
Electricity theory	0	0	53	20	6
Materials and installations	0	0	60	12	18
Electricial measurement	0	1	48	21	7
Electrical machines	0	23	54	19	4
Motion, regulation, control	0	23	22	5	17
Electrical goods industry	0	0	11	2	3
Industrial electronics	0	0	12	6	7
Electromechanical workshop	0	0	30	66	3
Measurement laboratory and apparatus	0	0	35	4	5
Machine laboratory	0	0	23	7	1
Electronics laboratory	0	0	10	7	2
Projects	0	0	0	0	3
Mechanical workshop	0	0	0	0	5

Maximum number of workers (100%): 647.

The number of workers required in future is greater than at present: 647 as compared with 250.

In four-year vocational schools a slight increase is required in training in electromechanical workshops. There is no need for a change in other electricity subjects.

Table 44: Predicted distribution of four-year school graduates according to the marks given to future requirements for electronics (percentages)

Electronics	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Electricity and network theory	0	0	34	66	
General electronics	0	0	39	10	53
Measurement	0	0	79	7	1
Electrical machines	0	17	70	11	0
Reception and transmission	0	0	70	3	0
Industrial electronics	0	0	72	1	20
Practical work and laboratories	0	0	88	3	1
V.H.F.	0	0	62	0	0
Television	0	0	46	0	17
Communications and communications apparatus	0	0	83	1	0
Automation and telemechanics	0	0	44	34	2
Constructions and production	0	15	0	0	0
Components	0	0	0	1	3

Maximum number of workers (100%): 1,035.

The number of workers required in the future is greater than that at present: 1035 as compared with 499.

In four-year vocational schools a great increase is needed in the study of general electronics and a small increase is needed in that of electricity and network theory. There is no need for a change in the present situation of other subjects in electronics.

4. Senior technical school graduates:

Table 45: Predicted distribution of senior technical school graduates according to the marks given to future requirements for general subjects (percentages)

General Subjects		Marks given to future needs				
		Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Hebrew	Oral exexpression	0	0	99	1	0
	Written expression	0	0	98	2	0
Technical English	Oral expression	0	0	3	91	6
	Written expression	0	0	0	91	8
Mathematics		0	0	80	7	2
Physics		0	14	75	9	2
Chemistry		0	14	74	3	5
Technical drawing, descriptive geometry, electrical drawing, schematics	Reading and understanding	0	0	78	18	2
	Knowledge of drawing	0	0	78	18	2

(Table continued on next page)

General Subjects	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Commerce, costing, technical reporting	0	0	2	0	3
Computers, theory and programming	0	0	0	0	0
Psychology of human relationships	0	0	0	0	16
Sociology and industrial management					
Safety and hygiene	0	0	9	1	90
Visits to industry and workshop practice	0	0	0	74	0

Maximum number of workers (100%): 1,117.

The number of workers required in the future is greater than that at present: 1117 as compared with 76.

In senior technical schools, a considerable increase is required in the study of safety and hygiene and a slight increase is required in that of English (oral and written expression) and in visits to industry and workshop practice. There is no need for a change in the other general subjects taught in the senior technical schools.

Table 46: Predicted distribution of senior technical school graduates according to the marks given to future requirements for qualifications (percentages)

Qualifications	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Self-learning capability	0	0	5	75	20
Capability to adjust to changes	0	0	2	24	74
Thinking in economic terms	0	0	74	3	0
Pride in manual labour	0	0	94	0	0
Team work	0	0	24	73	0
Efficiency consciousness	0	0	76	3	15
Quality consciousness	0	0	76	0	0
Responsibility	0	0	95	5	0
Agility	0	0	95	0	0
Precision	0	0	82	19	0
Special imagination	0	0	78	0	0

Maximum number of workers (100%): 1,106.

The number of workers required in the future is greater than that at present: 1,106 as compared with 51.

In senior technical schools it is necessary to increase the graduates' capability of adjusting to changes considerably. There is also a need for a slight increase in self-learning capability and team work. There is no need for a change in the remaining qualifications.

Table 47: Predicted distribution of senior technical school graduates according to the marks given to future requirements for electricity (percentages)

Electricity	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Technology and mechanics	0	0	0	12	7
Strength of materials and machine details	0	0	0	18	0
Engineering and heat	0	0	0	11	1
Electricity theory	0	0	80	8	12
Materials and installations	0	0	1	11	4
Electrical measurement	0	0	7	88	6
Electrical machines	0	0	7	4	7
Motion, regulation, control	0	0	0	6	10
Electrical goods industry	0	0	7	0	0
Industrial electronics	0	0	0	8	20
Electromechanical workshop	0	0	0	2	10
Measurement laboratory and apparatus	0	0	0	0	12
Machine laboratory	0	0	0	0	8
Electronics laboratory	0	0	0	1	7
Projects					
Mechanical laboratory					

Maximum number of workers (100%): 458.

The number of workers required in future is greater than that at present: 458 as compared with 62.

In the senior technical schools there is a need for much more study in the following electricity subjects: motion-regulation-control, industrial electronics and the various types of workshops and laboratories. There is a need for a slight increase in technology and mechanics, strength of materials and machine details, engineering and heat, materials and installations and electrical measurement. There is no need for a change in the other electricity subjects in the above schools.

Table 48: Predicted distribution of senior technical school graduates according to the marks given to future requirements for electronics (percentages)

Electronics	Marks given to future needs				
	Large reduction i	Slight reduction ii	No change iii	Slight increase iv	Large increase v
Electricity and network theory	0	0	3	12	86
General electronics	0	0	3	15	77
Measurement	0	0	4	1	89
Electrical machines	0	0	14	2	0
Reception and transmission	0	0	5	1	0
Industrial electronics	0	0	0	8	12
Practical work and laboratories	0	0	18	2	0
V.H.F.	0	0	5	0	8
Television	0	0	0	0	8
Communications and communications apparatus	0	0	1	6	0
Automation and telemechanics	0	0	8	12	1
Constructions and production	0	0	5	0	0

Maximum number of workers (100%): 405.

The number of workers required in future is greater than that at present: 405 as compared with 49.

There is a demand for considerably increased study in senior technical schools of the following subjects: electricity and network theory, general electronics, measurement, industrial electronics, V.H.F. and television. There is a need for a slight increase in the study of automation and telemechanics. There is no need for a change in the present situation of other subjects in electronics.

C. A comparison of the situation of the graduates at the different levels at present with that predicted for the future

Having studied the present situation of the graduates and their predicted situation in future, a comparison of these two situations should now be made. This comparison, as presented in table 49, indicates the deficiences of the present and the changes required in order to correct the situation in future.

Table 49 is divided into four main parts:

a. General subjects.

b. Qualifications.

c. Subjects studied in the electricity trend.

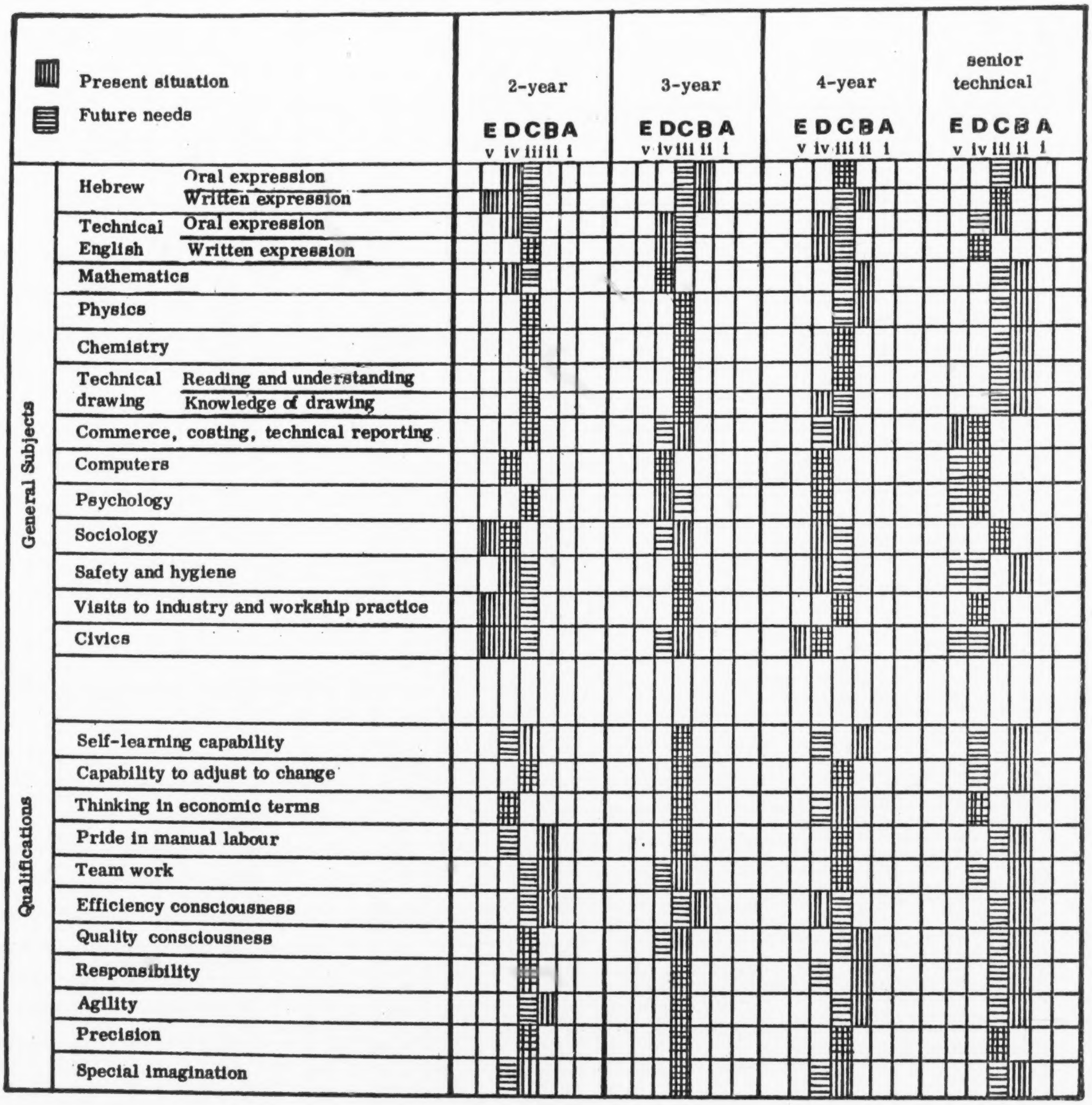
d. Subjects studied in the electronics trend.

Various marks were given to the subjects and qualifications and the averages of these marks appear in the table. The averages are divided according to the duration of study in the various vocation schools: senior technical, four-year, three-year and two-year (or short course).

A line passes through the centre of each school's column. The positive averages have been placed on its right, and the negative ones on its left. A and B indicate positive marks on the present situation whereas E and D indicate negative marks on the present situation. i and ii represent a need for a reduction of the vocation in future whereas iv and v represent a need for its increase.

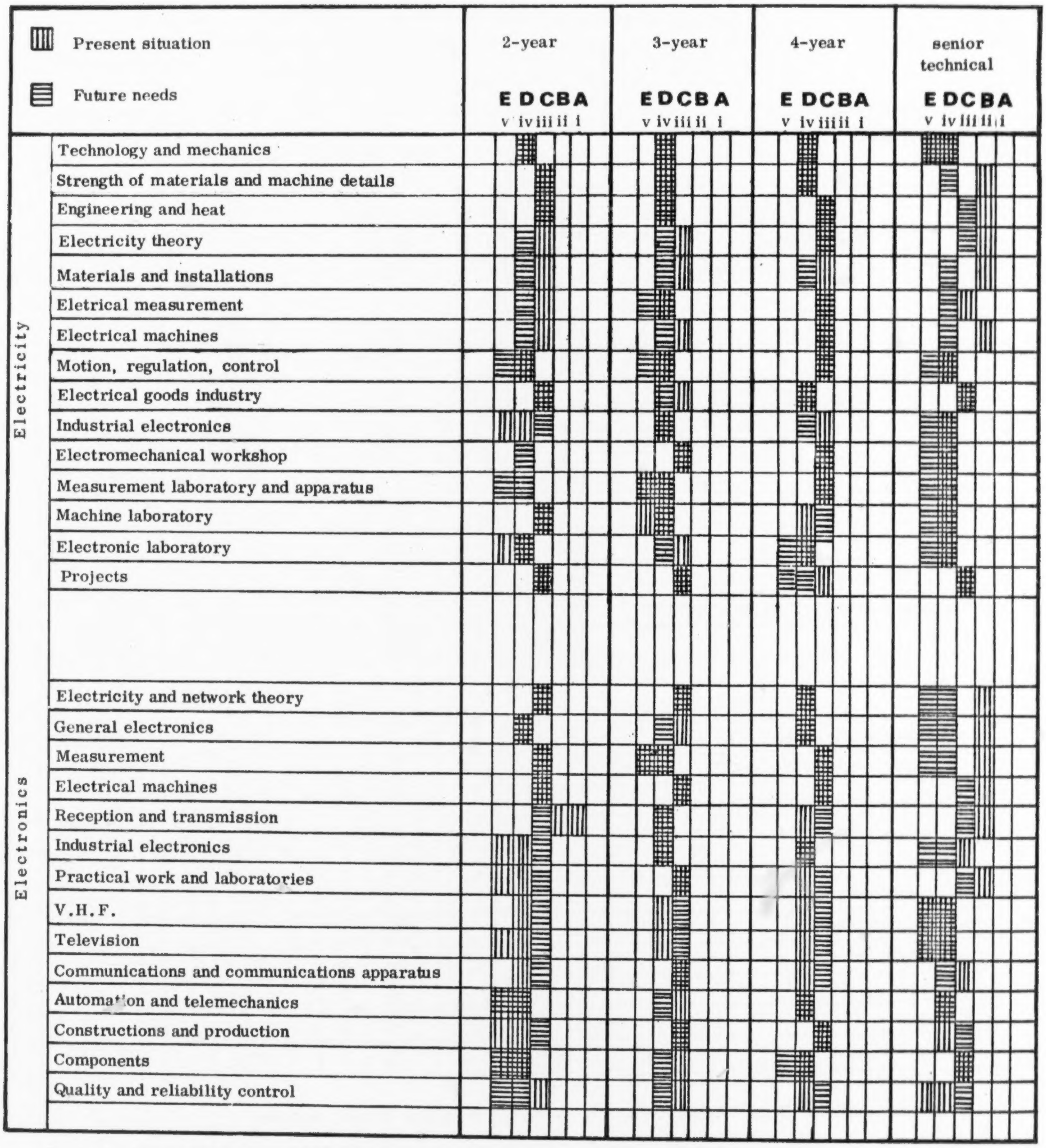
When reading the table it should be noted that there is a tendency towards a slight exaggeration of demands for the various subjects. Therefore most of the averages are marked to the left of the line passing the center. However, overlapping of the marks given at present and the future demands shows that a change is indeed required.

Table 49 : The present situation and future requirements according to levels of training and marks averages given to the various subjects and qualifications



Present : A-excellent; B-good; C-satisfactory; D-slightly deficient; E-very deficient

Future : i-large reduction; ii-slight reduction; iii-no change; iv-slight increase; v-large increase.



Present : A-excellent; B-good; C-satisfactory; D-slightly deficient; E-very deficient

Future: i-large reduction; ii-slight reduction; iii-no change;

iv-slight increas; v-large increas.

On the basis of the above tables' comparison of the graduates' present situation with the need for improvements in future, the position may be summarized in the following points:

1. Two-year vocational school or vocational courses:

General subjects - The present situation is deficient mainly in Hebrew - written written expression, computers - theory and programming, visits to industry and workshop practice, civics, sociology and industrial management.

In future, it is desirable to increase slightly the study of computers, sociology and industrial management.

Qualifications - The situation is generally satisfactory and there is no need for a considerable change. A slight increase in thinking in economic terms is desirable.

Electricity - The present situation is deficient mainly in industrial electronics - many comments were made on this point - and also in the electronics laboratory. In future it is desirable to increase mainly motion- regulation- control and measurements laboratory and apparatus.

Electronics - The situation at present is considerably deficient, principally in industrial electronics, practical work and laboratories, television, automation and telemechanics, constructions and production and components.

In future an increase is desirable in general electronics, automation, telemechanics and components.

2. Three-year vocational school:

General subjects - The situation at present is generally satisfactory except in English, mathematics and computers where it is slightly deficient.

In future it is desirable to increase study of mathematics, computers, sociology and civics.

Qualifications - Both the present and future situations are generally satisfactory.

Electricity - The present situation is deficient - even considerably - mainly in measurement laboratories, apparatus and machines and industrial electronics.

In future study should be increased in the fields of electrical measurements, motion-regulation-control and the above-mentioned laboratories.

Electronics - Generally speaking, the present situation is satisfactory but is slightly deficient in a number of subjects, especially measurement.

In future it is desirable to increase study mainly in general and industrial electronics, reception and transmission, V.H.F. and television.

3. Four-year vocational school:

General subjects - The present situation is generally satisfactory but is slightly deficient mainly in computers, psychology and sociology, safety and civics.

In future it is desirable to increase slightly the study of computers, psychology and civics.

Qualifications - The present situation is satisfactory and even good. In future it is desirable to increase slightly the development of self-learning capability, thinking in economic terms, responsibility and special imagination.

Electricity - The situation at present is satisfactory but there are slight deficiencies in technology and mechanics, strength of materials and machine details and laboratories.

In future it is desirable to increase study mainly in electronics laboratory and projects.

Electronics - The present situation is generally satisfactory but is slightly deficient mainly in electricity and network theory, general electronics, industrial electronics, automation, telemechanics and components.

In future it is desirable to increase study mainly in components, electricity and network theory, general and industrial electronics, automation and telemechanics.

4. Senior technical school:

Most of the remarks, both positive and negative, referred to the senior technical school.

General subjects - The present situation is satisfactory and even good but is considerably deficient in commerce, costing and technical reporting, and is slightly deficient in computers, psychology and visits to industry and workshop practice.

In future it is desirable to increase considerably the study of computers, psychology, safety and hygiene and civics. Study of English and the subjects mentioned as being deficient at present should be slightly increased.

Qualifications - The situation is generally good - both at present and in future. The development of thinking in economic terms is desirable.

Electricity - The situation at present is generally good but very deficient in technology and mechanics and slightly deficient in motion-regulation-control, industrial electronics and the various types of workshops and laboratories.

Electronics - Generally speaking the present situation is good but is very deficient mainly in V.H.F., television, quality control and testing, automation and telemechanics.

In future it is desirable to increase study considerably in: electricity and network theory, general electronics, measurement industrial electronics, V.H.F., television, automation and mechanics.

D. Types of training

In the framework of vocational schools, every occupation at the various professional levels is given a special training adapted to it. We attempted to examine whether the type of training really suited the professional level and the tasks fixed for each occupation; or, in other words, whether changes were required in the scope and type of training for each occupation.

1. The type of training at present as compared with the type of training desired in future:

Table 50: Distribution of workers in the various occupations according to the present type of training and their desired typed of training in future*

No. of occupation	Name of occupation	Employees' type of training	Course	2-year school or vocational course	3-year school	4-year school	technical school	senior technical	mode
1	Constructions electrician	present	12	66	7				2-year
		future		37	41	14			3-year
4	Maintenance and repairs electricians in factories and electronic networks	present	3	15	4	15			2-year
		future			26	47			4-year

(Table continued on next page)

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[*] The numbers of employees in future do not equal the present numbers due to the anticipated increase in their numbers.

No. of occupation	Name of occupation	Employees' type of training	Course	2-year school or vocational course	3-year school	4-year school	technical	senior technical	mode
5	Power-station electrician	present	50	17		3	7		3-year*
		future			80	16	23		3-year
6	Aircraft electrician	present							air-force cadet or 4-year
		future							ditto
8	Electrical machine production	present		4					
		future				5			
9	Production of various electrical appliances	present		12	3				2-year
		future			16	2			3-year
10	Power station operator	present		2		4			
		future			3	4			
11	Repairs electrician	present	7	19	5				2-year
		future		7	29	6			3-year
12.	Lighting electrician	present	5	12	12				2 and 3-year
		future		9	23	8			3-year

(Table continued on next page)

No. of occupation	Name of occupation	Employees' type of training	Course	2-year school or vocational course	3-year school	4-year school	technical	senior technical	mode
15	Automobile electrician	present		1	8				3-year
		future		1	7	2			3-year
18	Writer of technical literature on electricity	present							Technician
		future							ditto
19	Medical and x-ray equipment electrician	present							Senior technician
		future							ditto
21	Assembly of electrical equipment	present		29	7				2-year
		future			12	30			4-year
22	Construction of carriers and amplifer stations	present	200						course
		future		250					2-year

(Table continued on next page)

No of occupation	Name of occupation	Employees' type of training	Course	2-year school or vocational course	3-year school	4-year school	technical	senior technical	mode
23	Maintenance of carriers and amplifier stations	present				52			4-year
		future				150			4-year
24	Main distribution frame tester	present			140				3-year
		future				250			4-year
25	Construction of automatic public exchanges	present	200						course
		future		250					2-year
26	Maintenance of automatic public exchanges	present			130				3-year
						300			4-year
27	Power room construction	present	200						course
		future		250					2-year
28	Power room maintenance	present		20					2-year
		future			60				3-year

(Table continued on next page)

No. of occupation	Name of occupation	Employees' type of training	Course	2-year school or vocational course	3-year school	4-year school	technical	senior technical	mode
29	Subscriber equipment maintenance	present			330				3-year
		future				750			4-year
30	Teleprinter	present			40				3-year
		future				80			
31	Line transmission and balancing	present	15						course
		future			45				3-year
32	Maintenance of broadcasting and communications stations*	present				400			4-year
		future						800	senior technical
33	Network planning**	present							secondary school
		future				200			4-year
34	Mounting and maintenance of overhead network	present		250					2-year
		future			350				3-year
36 37	Construction and maintenance of stations, aerials and transmission lines*	present				400			4-year
		future						800	senior technical

(Table continued on next page)

* Includes the whole country.

** Add 100 secondary school graduates.

No. of occupation	Name of occupation	Employees' type of training	Course	2-year school or vocational course	3-year school	4-year school	technical	senior technical	mode
38	Laying and construction of underground network	present		170					2-year
		future			250				3-year
39	Underground cable maintenance	present		300					2-year
		future			500				3-year
40	Subscriber equipment installation	present		250					2-year
		future			400				3-year
42	Research and development of systems and circuits	present				40			4-year
		future				30		20	technical
43	Systems engineering	present				10		1	4-year
		future						22	senior technical
44	Circuit design	present				10	2		4-year
		future						20	senior technical
45	Technical training	present				10			4-year
		future						20	senior technical
46	Preparation of standards and specifications	present				10			4-year
		future						20	senior technical

(Table continued on next page)

No. of occupation	Name of occupation	Employees' type of training	Course	2-year school or vocational course	3-year school	4-year school	technical	senior technical	mode
47	Component layout	present				10	2		4-year
		future						20	senior technical
50	Preparation of testing instructions	present				1	3		technical
		future				2	5		technical
51	Estimation of labour and materials	present			2				technical
		future				3			technical
52	Writing of technical literature	present					2		technical
		future					3		technical
53	Fault localization and repair	present		13	19			1	3-year
		future			15	25		2	4-year
55	Guidance at work	present						5	senior techni-
		future						6	senior techni-
56	Installation of systems and auxiliary equipment	present			10			1	3-year
		future				11	1	2	4-year
57	Calibration and adjustment	present		2	4			1	3-year
		future				15	1	2	4-year

(Table continued on next page)

No. of occupation	Name of occupation	Employees' type of training	Course	2-year school or vocational course	3-year school	4-year school	technical	senior technical	mode
58	Electrical testing	present		8	11			2	3-year
		future				8	21	2	technical
59	Mechanical testing	present			8			4	3-year
		future				8	8		technical
60	Suitability testing	present			9			1	3-year
		future					9	2	technical
64	Assembly of miniature components	present	40						course
		future	80						course
65	Wiring	present		3					2-year
		future			1	3			4-year
66 67 68	Assembly, Soldering, Cleaning	present			8				3-year
		future			11				3-year
69	Servicing of communications and electronic equipment	present				11	8	1	4-year
		future				13	8	2	4-year

On the basis of table 50, we may classify the occupations according to their type of training at present and the type of training desired in future:

Occupations whose present training is two-year vocational school or vocational courses:

1. Constructions electrician.
4. Maintenance and repairs electrician in factories and electrical networks.
9. Production of various electrical appliances.
11. Repairs electrician.
12. Lighting electrician.
21. Assembly of electrical equipment.
28. Power room maintenance.
38. Laying and construction of underground network.
39. Underground cable maintenance.
40. Subscriber equipment installation.
65. Wiring.

Occupations where desired training in future is two-year vocational school or short courses:

22. Construction of carriers and amplifier stations.
25. Construction of automatic public exchanges.
27. Construction of power rooms.

Occupations where present training is three-year vocational school:

12. Lighting electrician.
15. Automobile electrician.
24. Main distribution frame tester.
26. Maintenance of automatic public exchanges.
29. Subscriber equipment maintenance.
30. Teleprinter maintenance.
53. Fault localization and repair.
56. Installation of systems and auxiliary equipment.
57. Calibration and adjustment.

58. Electrical testing.
59. Mechanical testing.
60. Suitability testing.
66. Assembly.
67. Soldering.
68. Cleaning.

Occupations whose desired training in future is three-year vocational school:

1. Constructions electrician.
5. Power station electrician.
9. Production of various electrical appliances.
11. Repairs electrician.
12. Lighting electrician.
15. Automobile electrician.
28. Power room maintenance.
31. Line transmission and balancing.
34. Mounting and maintenance of overhead network.
38. Laying and construction of underground network.
39. Underground cable maintenance.
40. Subscriber equipment installation.
66. Assembly.
67. Soldering.
68. Cleaning.

Occupations where present training is four-year vocational school or technical school:

6. Aircraft electrician.
18. Writing of technical literature on electricity.
23. Maintenance of carriers and amplifier stations.
32. Maintenance of broadcasting and communications stations.
36.)Construction and maintenance of stations
(
37.)aerials and transmission lines.

42. Development and research of systems and circuits.
43. Systems engineering.
44. Circuit design.
45. Technical training.
46. Preparation of standards and specifications.
47. Component layout.
50. Preparation of testing instructions.
51. Estimation of labour and materials.
52. Writing of technical literature on electronics.
69. Servicing of communications and electronic equipment.

Occupations where desired training in future is four-year vocational school or technical school:

4. Maintenance and repairs electrician in factories and electric network.
6. Aircraft electrician.
18. Writing of technical literature on electricity.
21. Assembly of electrical equipment.
23. Maintenance of carriers and amplifier stations.
24. Main distribution frame testers.
26. Maintenance of automatic public exchanges.
29. Subscriber equipment maintenance.
30. Teleprinter maintenance.
33. Network planning (+secondary school graduates).
36.)Construction and maintenance of stations,
(
37.)aerials and transmission lines.
42. Research and development of systems and circuits.
50. Preparation of testing instructions.
51. Estimation of labour and materials.
52. Writing of technical literature or electronics.
53. Fault localization and repair.
57. Calibration and adjustment.
58. Electrical testing.
59. Mechanical testing.

60. Suitability testing.
65. Writing.
69. Servicing of communications and electric equipment.

Occupations where present training is senior technical school:

19. Medical and x-ray equipment electrician.
55. Guidance at work.

Occupations where desired training in future is senior technical school:

19. Medical and x-ray equipment electrician.
32. Maintenance of braodcasting and communications stations.
36.)Construction and maintenance of stations,
(
37.)aerials and transmission lines.
43. Systems engineering.
44. Circuit design.
45. Technical training.
46. Prepation of standards and specifications.
47. Components layout.
55. Guidance at work.

2. Desired training for electrical and electronics engineers:

Table 51: Distributions of opinions of the interviewees as to what training is desirable for electrical and electronic engineers

Task	Vocational school background (percentage of interviewees)	
	Yes	No
General management	45%	55%
Technical management	85%	15%
Planning and development	95%	5%
Sales	45%	55%

The other background proposed for general management tasks is ordinary secondary school or business-management. The other background proposed for sales tasks is a commercial one.

E. Quantitative relationships between the general number of employees and the number of electricians and electronics technicians at present and in the future

Table 52 presents us with information on the firms included in the sample according to the various sub-branches. The general number of employees, the number of electricians and electronics technicians and their predicted number in future are given for every sub-branch. The electricians and electronics technicians as a percentage of the total number of employees and the anticipated growth in their numbers are also given.

Table 52: Distribution of electricians and electronics technicians according to industrial branches at present and in the future and the predicted percentage rise

Branch	No. of firms in sample	General No. of employees	No. of electricians and electronics technicians	No. of electricians and electronics technicians predicted in future	Electricians and electronics technicians as of total no. of employees*	Predicted percentage increase of electricians and electronics technicians*
Electrical installation and lighting equipment	3	360	26	30	73%	15%
Electrical motors and transformers	1	71	63	-	90%	-
Electrical domestic appliances, air-conditioners, elevators, washing-machines	1	155	30	-	20%	-
Radio gramophone and television	1	420	50	100	12%	100%

(Table continued on next page)

* rounded to nearest percent.

- = no information.

Branch	No. of firms in sample	General No. of employees	No. of electricians and electronics technicians	No. of electricians and electronics technicians predicted in future	Electricians and electronics technicians as of total no. of employees*	Predicted percentage increase of electricians and electronics technicians*
Communications instruments	1	500	30	60	6%	100%
Electronic instruments for science and medicine production and repair	2	225	43	-	19%	-
Research	1	1,350	40	-	30%	
Tyres, inner-tubes and belts	1	760	38	56	5%	47%
Asbestos pipes and boards	1	400	66	68	16.5%	12%
Metal pipes	1	350	80	106	22.7%	40%
Petroleum products	1	1,100	70	80	6.4%	14%
Threads, cloth and ready-made clothing	1	1,800	8	-	0.4%	-
Operation and maintenance of electrical network - one area only	1 area only		74	115	-	46%
Aviation services	1	2,700	29	-	1%	-

(Table continued on next page)

* rounded to nearest percent.

- = no information.

Branch	No. of firms in sample	General No. of employees	No. of electricians and electronics technicians	No. of electricians and electronics technicians predicted in future	Electricians and electronics technicians as of total no. of employees*	Predicted percentage increase of electricians and electronics technicians*
Production and overhaul of aircraft	1	6,000	-	-	-	-
Hospitals	1	-	32	50	-	57%
Cement and building materials	1	417	13	16	3%	23%
Food	1	-	26	28	-	8%
Postal services	See separate table				-	100-200%
Israel Defence Forces and security network	No numbers submitted - only marks					

*rounded to nearest percent.

- = no information.

In the sample which served as the basis of this survey, the number of electricians and electronics technicians as a percentage of the total number of workers fluctuated between 0.4% and 90%, whereas the anticipated growth fluctuates between 8% and 200%. In other words, the higher increase anticipated represents a threefold increase over the present number of workers. This is the case with the Ministry of Posts in which the number of electricians and electronics technicians is higher than in any other enterprise included in the sample (for details, see table 53).

Table 53: Forecast of manpower to be trained in the engineering services of the Ministry of Posts, according to profession and type of employment (percentages)

Profession Type	Construction		Maintenance		Laying and connection		Carriers	Telephones	Military	Trunk dialing	Underground construction	Work for payment		Workshops	Administration	% workers to be trained among present staff	
	T	W	T	W	T	W	T	T	T	T	W	T	W	-	-	T	W
Carriers							100									½	
Testers	1/3		5	5	5				16							2	
Telephone exchanges	6	25	20	20					42	100						6	
Private branch exchanges			6						5								
Coin-collecting boxes			14						3							¾	
Subscriber equipment			20						8							4½	
Teleprinter								100								¾	
Balancing and cable welding	3	20		5	30												3

Profession Type	Construction		Maintenance		Laying and connection		Carriers	Telephones	Military	Trunk dialing	Underground construction	Work for payment		Workshops	Administration	% workers to be trained among present staff	
	T	W	T	W	T	W	T	T	T	T	W	T	W	-	-	T	W
Network	1/3	6		5													2
Underground and laying	1/3	11				70					100						
Installation	5	23							16			40	60			½	4
Administration and misc.									10					100	100		
Total % technicians	15	X	65	X	30	X	100	100	90	100	X	40	X	X	X	15	X
Total % workers	X	85	X	35	X	70	X	X	X	X	100	X	60	X	X	X	9
Total %	100		100		100		100	100	100	100	100	100		100	100	24	

T = Technician

W = Worker

F. Details of new occupations

One of the questions to which the interviewees were asked to reply was aimed at clarifying whether there were any new electrical or electronic occupations in the firms which had not been included in the questionnair's list of occupations (see appendix A). It turned out that there were 32 such new occupations. They are listed below by name and definition:

1. Maintenance of electronic equipment in aircraft.
2. Overhaul of airborne avionic electronic equipment.
3. Overhaul of electrical avionic equipment.
4. Overhaul of instruments.
5. Maintenance of electrical systems and instruments.
6. Air-condition technician. Field of knowledge - air-conditioning. Increase of engineering and heat and automation .
7. Technology of printed circuits.
8. Design of printed circuits.
9. Multi-layered printed circuits.
10. Integral circuits.
11. Digital logical circuits.
12. Pulse circuits.
13. Transistor circuits.
14. Design of circuits for new technologies.
15. Transformers.
16. Components - reliability and efficient use (study of work in catalogues).
17. Preparation of information.
18. District inspector - electricity network - operation and maintenance of networks and installations.
19. Supervisors of electricity network - electricians who operate on and repair the network.
20. Regional inspectors of electricity lines - (high tension) responsible for operation of high tension systems in each region.
21. Maintenance technician - measurements to localize faults in cables and special technical works.

22. Cardiovascular work -open heart surgery; tests (catheterization) of heart systems; electronic monitoring of heart patients. Field of knowledge: x-rays and television, cardiology and auxiliary apparatus, design of monitoring apparatus.

23. Closed circuit television systems - fields of knowledge - as above.

24. Shift-work electrician - responsible for the regular operation of electrical machines and the supply of tension in all parts of the plant. The knowledge required is a basic one of all the machines and works carried out in the plant including a knowledge of the latter's electricity network.

25. Design of electrical installations - calculations and blueprints of industrial electrical installations.

26. Preparation and formulation of maintenance instructions - keeping a card-index.

27. Maintenance of industrial analytical instruments - fields of knowledge: physical chemistry and physics.

28. Telemetrics.

29. Communications workshop technician - repair and maintenance of communications instruments of all types, including high-power transmission equipment; various development works connected with communications equipment; preparation of production files and calculation of quantities production.

30. Carrier-equipment (communications) technicians - repair and maintenance of various types of carrier equipment instruments (4, 12, 24 channels), including the transmitting equipment itself (V.H.F. and U.H.F.), supervision and production of various auxiliary instruments in the above field.

31. Assembly, construction and measurement - assembly of miniature printed circuits with the aid of a microscope. Knowledge is required in precision mechanics as well as electronics.

32. Pneumatic tool-operation - control system, piping, fundamentals of pneumatics, valves, supervision and control systems.

G. The rise and fall in the importance of subjects and qualifications during the next decade

One of the secondary aims of this survey was to study the subjects and qualifications whose importance would increase during the next decade and those whose importance would decline in the same period and a special question was included in the questionnaire with this aim in mind. In accordance with the interviewees' replies we may summarize the situation as follows:

Subjects and qualifications which will rise in importance during the next ten years:

- Transistors
- Constructions electrician
- Tool operation
- Transistor work
- Advanced methods in electronics
- More experience in maintenance
- Preparation of production files and production control
- Industrial electronics
- High tension
- Electromechanical workshop
- Electrical machines
- Communications and communications apparatus
- Pulse technics
- Electricity and network theory
- Electronic switching
- Psychology of human relationships
- Precision and team work
- self-learning
- Television
- Electronic control systems
- Printed circuits
- Motion-regulation control
- Quality consciousness
- Responsibility and efficiency
- Practical work

Subjects and qualifications which will decline in importance during the next ten years:

Tubes.
Plumbing.
Mechanics and mechanical problems.

H. Machines and instruments with which graduates should be trained to work

This question too - which machines and instruments graduates should be trained to operate - was one of the survey's aims and the interviewees were therefore asked to give their opinion on it in the questionnaire. It turned out that the following machines and instruments require special training:

Oscilloscope, oscillator.
Stabilizer current rectifier.
Electronic power suppliers.
Automatic control systems.
V.T.V.M.
Measurement and testing instruments connected with low frequency telecommunication.
High frequency welding and hardening.*
Electrical control instruments.
Automatic control instruments.
Electrical equipment in anti-explosion protective casing and special instructions to install and maintain the equipment.*
Transmitter adjustment.*
Analytical instruments (measurement of 2 percent), pH, viscosity, specific gravity, etc.*
Digital instruments.*
Generators for high frequency.
Modern welding appliances*
Vitrasonic testing equipment.*

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*Specific to a few occupations.

Pulse and signal generator.
Counting instruments and time determinants.
L/C measurers.
Magnetic amplifiers.*
Circuits.
Work with a microscope in assembly and construction of miniature circuits.*

I. The form of ownership of the firms

The form of ownership of the firms was also a secondary aim of the survey. It is described in table 54.

Table 54: Distribution of industrial firms according to form of ownership

Form of ownership	No. of establishments
Owned by a single person	0
Owned by a number of partners	2
Private share company	5
Public share company	6
Cooperative society	0
State enterprise	5
Histadruth (Confederation of Labour enterprise)	2
Israel Defence Forces, security network	X
Public direction	1
Post	2 areas and a department

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*Specific to a few occupations.

J. The extent of dropping out from the profession

Question No. 10 of the questionnaire attempted to find out the extent of dropping out from the profession and its reasons. It was formulated as follows: Have vocational school graduates dropped out in the past from skilled occupations which required vocational training and transferred to occupations not connected with the skill which they had acquired at vocational school?

The following are the replies of the interviewees to this question:

Number replying "yes"	Number replying "no"	Number replying "I have no idea"
51	40	9

Together with the reply to this question, the interviewees were requested to give the reasons for dropping out from electrical and electronic occupations. The reasons given were as follows:

1. The wish to advance.	32%
2. The desire for work in administration instead of skilled work.	28%
3. Dissatisfaction at work.	16%
4. Financial motives.	11%
5. Non-integration into team work.	9%
6. Medical limitations.	4%

Section IV - Summary and Conclusions

This survey was carried out in order to study the extent of the quantitative and qualitative changes required within the framework of the vocational school in order that they adapt themselves as far as possible to the needs of the firms and the market.

The opinions of the managers and engineers who were approached via the questionnaire show that the vocational education graduate's level of knowledge and extent of training are satisfactory. However, in a number of subjects, which have been mentioned in the course of the report, the situation is still deficient and the level of their study as well as learning requirements must be raised.

The interviewees, who actually expressed positive opinions about the graduates, made a number of comments on the vocational education provided at present and they put forward some practical proposals for the advancement of this education. They claimed in particular, that the direct contact between vocational school pupils and industrial establishments should be strengthened by frequent visits to the latter. They also demanded changes in the curriculum.

It appears that a considerable increase is anticipated in the number of electricians and electronics technicians, and it is likely to amount to three times the present number (in the Ministry of Posts). But it has also been noted that a certain dropping out from the industry takes place for various reasons such as continuation of studies, transfer to administrative work, dissatisfaction at work, etc.

It appears from the remarks of the interviewees - who are, after all, familiar with the problems - that not only is a quantitative growth anticipated in the electricity and electronics industry; certain subjects (transistors, television, etc.) will also increase in importance and new occupations will also develop such as district inspector, maintenance technician, etc.

Present		Future	
A	Excellent	i	Reduce considerably
B	Good	ii	Reduce slightly
C	Satisfactory	iii	No change
D	Slightly deficient	iv	Increase slightly
E	Very deficient	v	Increase considerably

	Name of occupation		No. of occupation Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future
General Subjects	No. of employees in occupation														
	Training of majority of employees in occupation														
	Hebrew	Oral expression													
		Written expression													
	Technical English	Oral													
		Written expression													
	Mathematics (14)														
	Physics (14-15)														
	Chemistry (15)														
	Technical drawing, descriptive geometry, electrical drawing, hematics (16)	Reading and understanding													
		Knowledge of drawing													
	Commerce, costing, technical reporting (17)														
	Computers, theory and programming														
	Psychology of human relationships														
	Sociology and industrial management (18)														
	Safety and hygiene (18)														
	Visits to industry and workshop practice														
Qualifications	Self-learning capability														
	Capability of adjusting to change														
	Thinking in economic terms														
	Pride in manual labour														
	Team work														
	Efficiency consciousness														
	Quality consciousness														
	Responsibility														
	Agility														
	Precision														
	Special imagination														
Remarks															

Present			Future		
A	Excellent		i	Reduce considerably	
B	Good		ii	Reduce slightly	
C	Satisfactory		iii	No change	
D	Slightly deficient		iv	Increase slightly	
E	Very deficient		v	Increase considerably	

	No. of Occupation													
	Name of occupation													
		Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future	Till No. Present Future
Electricity	No. of employees in occupation													
	Training of majority of employees in occupation													
	Technology and mechanics (19)													
	Strength of materials and machine details (19, 20)													
	Engineering and heat (35)													
	Electricity theory (20-21)													
	Materials and installations (21-23)													
	Electrical measurements (23-24)													
	Electrical machines (24-26)													
	Motion-regulation-control (26)													
	Electrical goods industry (27)													
	Industrial electronics (30)													
	Electronics workshop (30)													
	Measurement laboratory and apparatus (27-28)													
	Machine laboratory (28)													
	Electronics laboratory													
	Projects (28-29)													
Electronics	Electricity and network theory (29)													
	General electronics (29)													
	Measurement (31)													
	Electrical machines (31)													
	Reception and transmission (32)													
	Industrial electronics (32)													
	Practical work and laboratories													
	V.H.F. (34)													
	Television (33)													
	Communications and communications apparatus (33)													
	Automation and telemechanics (33)													
	Constructions and production (33)													
	Remarks													

1. Name of firm, company (business).
2. Firm's address:

Town/Settlement
Quarter or industrial center
Street
No.
Telephone

3. Principal products manufactured by the firm (in order of annual turnover).

A.
B.
C.
D.
E.

4. Date of opening.

a. Date of opening at present address 19________.
If the firm operated in the past at another address in Israel, please state.

b. Date of opening at first address in Israel 19________.
If the firm operated in the past abroad, please state.

c. Date of opening abroad __________.

5. Form of ownership (please check the appropriate square).

   a. ☐ Owned by a single person.

   b. ☐ Owned by a number of partners.

   c. ☐ Private share company.

   d. ☐ Public share company.

   e. ☐ Cooperative society.

   f. ☐ State enterprise.

   g. ☐ Histadruth.

   h. ☐ Other (state type).

6. Number of employees in firm at present.

   a. How many workers are employed in posts connected with production (excluding engineers) (as opposed to sales and administrative posts).

      1. Production and maintenance workers ____________

      2. Technicians, quality testers, officials, foremen and managers ____________

      3. Total ____________

   b. How many workers are employed outside the plant (excluding engineers).

      1. In management, administration, sales and office work ____________

      2. Customer services ____________

      3. Total ____________

c. Number of engineers.

1. In administrative posts ____________
2. In research and devlopment ____________
3. In sales posts ____________
4. Other ____________
5. Total ____________

d. Remarks ____

____

7. Give a short description of the occupations which you added to the original list and indicate what the most important fields of knowledge are for training workers for the above-mentioned additional occupations.

No.	Occupation Name	Description	Fields of knowledge or principal subjects

8. Of all the subjects, qualifications and skills listed above, stated two which, in your opinion, will increase in importance to a greater extent than others, taking into consideration the needs of your firm during the next ten years.

	For skilled workers	For administrative and supervisory tasks
Subjects		
Qualifications		

Which two, in your opinion, will decline in importance, taking into account the needs of your firm?

	For skilled workers	For administrative and supervisory tasks
Subjects		
Qualifications		

9. Do you consider it desirable that your firm's engineers who fill the following posts have a vocational school background?

a. General management posts ____ Yes ____ No ________ which background?

b. Technical management posts ____ Yes ____ No ________ which background?

c. Development and research posts ____ Yes ____ No ________ which background?

d. Sales posts ____ Yes ____ No ________ which background?

10. Have vocational school graduates dropped out in the past from skilled occupations which required vocational training and transferred to occupations not connected with the skill which they had acquired at vocational school?

☐ Yes ☐ No ☐ I have no idea

11. What, in your opinion, caused the dropping out from the vocation?

12. What is your suggestion to improve the training given at vocational schools in order to prepare their graduates for the requirements of the industry?

13. If there are particulars which you regard as important and to which we have not referred, please add them and give your opinion on them.

Name Surname
of the interviewee

Positition in Firm

Name of Firm ____________________

Name of interviewee ____________________

1. Machines and instruments being used by the firm and with which, in your opinion, it is desirable to train graduates to work in the course of their studies at vocational school.

2. Machines and instruments which are likely to be used by the firm during the next 8-10 years and with which, in your opinion, it is desirable to train graduates to work in the course of their studies at vocational school.

Signature ____________________

Following are a list of occupations in the field of electricity and electronics together with their definitions and a list of subjects learnt in the framework of vocational education.

State the names of the occupations which exist in your firm today and which are planned for the future. Study the attached details of the subjects learnt and give marks to the present situation of each occupation and to the one required in future. The marks are detailed in the table.

If you indicate a deficiency in any subject, state in the "remarks" column in which sphere the deficiency is to be found according to the details of the subjects.

If you add an occupation which does not appear in the list, write its definition on the special page attached for this purpose.

List of occupations in electricity and their definitions

1. Constructions electrician (buildings and installations) 4-97.000
Installation of electrical accessories, piping in buildings, electrical connections and electrical boards.

2. Stage and film electrician 49-97.100
Connection and operation of electrical systems for stage and films.

3. Ship electrician 4-97.200
Maintenance and repair of electrical systems in ships.

4. Maintenance and repair electrician in factories and electricity network 4-97.400
Repair of electrical machines and electrical systems, examination of complaints, repair of control systems, cranes, time-clocks.

5. Power station electrician 4-97.500
Repairs of electrical systems in power stations.

6. Aircraft electrician 4-97.910
Repair of electrical systems in aircraft.

7. Railway electrician 4-97.921
Repair of electrical systems on railways.

8. Electrical machine production 4-99
Production and winding of electric motors and electric transformers.

9. Production of various electrical instruments 5-00

10. Power station operator 5-51.00
Supervision of control boards, duty electrician in stations, localization and report of faults.

11. Repairs electrician 5-83.410
    a. Test and repair of radio instruments.
    b. Test and repair of domestic electrical appliances.
    c. Test and repair of electrical tools (drill, grinder, etc.)
    d. Test and repair of x-ray systems.

12. Lighting electrician
Test and repair of regional lighting network.

13. Traffic-lights electrician
Test and repair of traffic lights.

14. Airport electrician
Test and repair of airport electrical network.

15. Automobile electrician
Test and repair of electrical systems in automobiles.

16. Broadcasting electrician 0-66.00
Technical control of broadcasts, recordings on tapes, technical execution of programme assembly, outside broadcasts, responsibility for shift, switching of various broadcasts and responsibility for continuity of broadcasts.

17. Broadcast supervisor in broadcasting studio

Supervision of shift-workers, recording on tapes and broadcast execution, organization of the shift's work and guidance of the workers. Supervision of the regular functioning of the transmitters.

18. Writing of technical literature in electricity

Editing and formulation of technical publications such as handbooks, maintenance instructions and the like.

19. Medical equipment and x-ray electrician

Operation and repair of medical and x-ray equipment.

20. Operators of turbines and diesels

21. Assemblers of electrical equipment

Postal Occupations

Internal Engineering postal services

22. Construction of carriers and amplifier stations

Construction of carrier equipment and amplifier stations, installation, connection and testing of frameworks.

23. Maintenance of carriers and amplifier stations

Preventive maintenance of carrier equipment and amplifier stations, localization, repair and report of faults.

24. Main distribution frame testers

Test of subscriber equipment in main distribution frames, localization and report of faults, replacement of subscriber's bridges.

25. Construction of public automatic exchanges

Construction of framework of public automatic exchanges (Stroger, Alvis, Rotory (Bell), trunk exchanges (Alvis), classification machines, telex exchanges). Repair, connection, testing and transfer to maintenance personnel.

26. Maintenance of public automatic exchanges
Preventive maintenance of public automatic exchanges, localization, repair and report of faults.

27. Power room construction
Installation of control boards, current rectifiers and batteries.

28. Power room maintenance
Preventive maintenance of power rooms, localization, repair and report of faults.

29. Subscriber equipment maintenance
Maintenance of subscriber equipment starting from the distribution box, maintenance of C.C.B.s (coin collecting boxes), maintenance of private automatic branch exchanges, preventive maintenance of private automatic branch exchanges of of the Alvis, Stroger, and Rotary types. Localization, repair and report of faults.

30. Teleprinter maintenance
Preventive maintenance of teleprinters, localization, report and repair of faults.

31. Line transmission and balancing

32. Maintenance of broadcasting and communications stations
Preventive maintenance of broadcasting and communications stations, localization, report and repair of faults.

33. Network planning
Planning of various combinations of telephone equipment for use in given conditions, forecast and calculation of the conduct of the equipment in the given conditions.

External engineering postal services

34. Mounting of overhead network
Installation of masts, connection and disconnection of overhead wires or cables.

35. Maintenance of overhead network
Preventive maintenance of overhead network, localization, report and repair of faults.

36. Construction of transmission stations, aerials and lines.

37. Maintenance of transmission stations, aerials and lines.
Preventive maintenance of transmission stations, aerials and lines, localization, report and repair of faults.

38. Laying and construction of underground network
Installation of pipes, stretching and connection of underground wires or cables.

39. Maintenance of underground cables
Preventive maintenance of underground cables, air pressure equipment, localization, repair and report of faults.

40. Installation of subscriber equipment
Installation of subscriber equipment starting with the distribution box, including private exchanges.

41. Electricians

List of principal occupations in electronics

42. Discovery of applications for scientific innovations and principles. Invention of new uses for circuits, components and existing materials.

43. Systems engineering
Design of various combinations of electronic equipment for use in given conditions, forecast and calculation of the equipment's conduct in the given conditions.

44. Circuit design

Choice and rectification of circuits, choice of components and calculation of their values. Summary of specifications, measurements.

45. Technical training

Preparation of curriculum and courses of further education. Lectures according to a given programme, demonstration and practice of material studied. (Use of instructional accessories and teaching aids). Holding of examinations.

46. Preparation of standards and specifications

Formulation of standards or specifications for equipment, circuits or components.

47. Layout of components

Determination of layout of components in a given circuit, taking into consideration the mechanical and electrical data.

48. Experimentation and measurement

Determination of a system of measurements, choice of measuring instruments, calculations and reports.

49. Product design

Determination of the physical form of a product, choice of the appropriate materials for its production taking into account principles of human engineering, processes of production and paying attention to its aesthetic appearance.

50. Preparation of testing instructions

Determination of methods of testing and the drawing-up of testing instructions in order to ensure that the equipment complies with the specification data.

51. Estimation of labour and materials

Analysis of labour and estimation of work hours to be invested in the materials needed for the development, production maintenance and installation of equipment.

52. Writing of technical literature in electronics

Editing and drafting of technical publications such as handbooks, maintenance instructions, etc.

53. Localization and repair of faults

Diagnosis, analysis and repair of faults.

54. Preparation of production files

Preparation of production documents such as production guidelines, working blueprints, lists of components and raw materials.

55. Guidance at work

Demonstration, explanation and organization of workers in work processes and supervision of execution.

56. Installation of systems and accessory equipment

Choice of place for installation, location and determination of systems, equipment and accessories; trial and operation of the installation.

57. Calibration and adjustment

Calibration of instruments in a laboratory using standard measuring instruments. Adjustment of instruments or systems in preparation for their operation or periodic test.

58. Electrical testing

Testing of the technical data of equipment in accordance with standards and specifications using measuring instruments and specific apparatus.

59. Mechanical testing

Measuring or verification of measurements, quality of materials, work and finish, test of compliance with standards and specifications (use of gauges, measuring tools and specific apparatus).

60. Test of suitability

Suitability control of equipment after assembly or course of preventive maintenance in order to ascertain if the execution of the skilled work is in accordance with the required quality.

61. Chemical preparation

Electrolytic corrosion of materials, preparation of solutions according to written prescriptions whilst observing a fixed time for the operation or a standard temperature in the apparatus.

62. Crystal and semi-conductor preparation

Processing, polishing, sawing, testing of width and orientation of semiconductors and crystals using precision mechanical and optic equipment.

63. Welding and soldering of miniature components

Connection of metal parts or semi-conductive materials parts by point-welding, immersion in a tank or using soldering tools and pliers, small welding equipment and specific complex equipment.

64. Assembly of miniature components

Treatment of miniature components, installation of contacts and parts with the aid of a microscope or other specific complex equipment.

65. Wiring

Arrangement of wires on switchboards, their connection, strengthening, plaiting and cutting according to measure and exposal of their insulation according to plan.

66. Assembly

Assembly of instruments or units from parts, tightening of screws, rivetting, glueing and tying according to plan or instructions using simple tools.

67. Soldering

Connection of wires or components to terminals on chassis or printed circuit according to plan using special tools.

68. Cleaning

Cleaning of instruments or sub-units of equipment by mechanical or chemical means, working according to instructions and under supervision.

69. Servicing of communications and electronic equipment

Regulation, adjustment and maintenance of instruments in accordance with instructions, reading of indicators and submission of reports on deficiencies.

Mathematics

1. Algebra - quadratic equations, powers and roots, logarithims, factorization, algebraic fractions, simultaneous equations, series, graphic descriptions and solutions, determinants.

2. Geometry - definitions, characteristics constructions and theorems.

3. Trigonometry - trigonometrical functions, graphic descriptions, functions of complex rights, theorems, trigonometrical solutions, trigonometrical equations.

4. Analytic geometry - cartesian systems, hyperbole, principles of solid geometry.

5. Differential and integral calculus - concept of functions, concept of limits, derivative, rules of derivatives, derivatives of trigonometrical and logarithmical functions, uses of differential calculus, uses of integral calculus, differential equations.

6. Special subjects -

   a. Use of slide rule.
   b. Complex numbers.
   c. Calculation of errors.
   d. Elements of statistics.
   e. Elements of the theory of functions.
   f. Determinants and matrices.
   g. Fundamentals of Vectorial calculus.
   h. Fourier progressions.
   i. Laplace transformations.

Physics

1. Principles of mechanics - units of power, work, supply.

2. Liquids and gases - units, laws, instruments.

3. Theory of heat - temperature and thermometers, expansion of solids, liquids and gases, thermal quantity, thermal capacity, calorie mechanic equivalent of heat, instruments.

4. **Elasticity and waves** - simple harmonic movement, longitudinal and transversal waves, rate of wave propogation, light waves, sound waves.

5. **Acoustics** - speed of sound, height, intensity and diversity of tones, structure of the ear, reactions to frequency, intensity and strength. Measurement of sound intensity.

6. **Electricity and magnetism**

7. Light theory (optics) - light and its sources, concepts in photometrics (light intensity, speed of light), units, refraction and reflection, prisms, lenses, the eye, optical instruments, colours, sensitivity of the eye to colours, colour diagrams.
8. Subjects in modern Physics.

Chemistry

1. **General chemistry** - basic laws, elements and their division, structure of material, atomic and molecular weight, structure of the atom. Chemical Valance and formulae. Oxygen and its consumption, oxygen in industry. Hydrogen, its production and uses. Oxidation, basic acids and salts. Electrolysis, Faraday's laws, theory of ions.

2. **Water** - water as a chemical, water solutions, melting and crystallization, solution concentrates. Water in nature, water in industry, physical and chemical treatment of water, water tests, desalination of sea-water.

3. **Halogens** - chlorine, iodine, bromine, etc.

4. **Sulphur** - uses, production, acids, etc.

5. **Nitrogen** - production, ammonium acids, etc.

6. **Metals** - physical and chemical properties, the electro-chemical characteristics, elements of metallurgy.

7. Fuel and lubricating materials - elements of organic chemistry, hydrocarbons, types of fuel (solid, liquid), types of coal, thermal value, crude oil (extraction and processing, petrol, paraffin, solar oil, heating oil). Lubricating oil - properties and uses.

Technical drawing and descriptive geometry

1. Elements of technical drawing.
2. Geometrical drawing.
3. Theory of projections.
4. Isometric drawing.
5. Cross-sections.
6. Blueprints.
7. Screw-threads.
8. Costing.
9. Constructions.
10. Cog-wheel drawing.
11. Assembly drawing.
12. Drawing of parts of electrical appliances.
13. Concepts of building drawing.
14. Introduction to descriptive geometry.
15. Projections and cross-sections.
16. Second degree curves.
17. Permeability.
18. Extensibility.

Electrical drawing and schematics

1. Introduction: electrical drawing is divided into four basic sections.
2. Single-line sketch.
3. Drawing of electrical installations in buildings - dwellings and industrial constructions - lighting and power.
4. Elementary sketch.
5. Contacts sketch.

Commerce, costing and technical reporting

1. Commerce

Types of business, credit, loans and bonds, promissory notes, cheques and banking activities. Means of payment, bookkeeping, types of accounts, vouchers, obligatory signatures, trial balance, annual balance sheet. Profit and loss account, balance sheet analysis, taxes and profits, income tax and funds.

2. Costing and planning

Role of costing, fixed and variable costs, calculation according to product, calculation according to processes, data collection-wages, material, depreciation, interest, standard costing, budgets.

Different types of production, pre-planning - fixing of quantities for production, order of operations and times, advancement and reporting, advancement table, design of forms and their execution, the place of planning in the firm's organization, integration of planning and control with costing.

3. Technical reporting

Commercial correspondence, structure and content of various letters. Methods of technical reporting.

Sociology and industrial management

1. Technological change since the industrial revolution.
2. The economy and industry.
3. The industrial firm and society.
4. Principles of administration theory.
5. The individual industrial firm - formal structure.
6. The individual industrial firm - informal structure.
7. Industry in Israel.
8. Trade unions and labour relationships in Israel.
9. Social legislation in Israel.
10. Legislation and standards in the field of electricity.

Safety and hygiene

1. Work accidents and their classification.
2. Reasons for work accidents.
3. Prevention of work accidents.
4. Laws and standards for the prevention of work accidents.
5. Fires.
6. Occupational diseases.
7. Hygiene at work.
8. Supervision of the worker's health.
9. Organization of safety at the plant.
10. First aid.

Technology and mechanics

1. Theory of materials.
2. Theory of tools.
3. Review of machines and tools.
4. Processing.
5. Autogenic welding.
6. Electric welding.
7. Spot welding.

Technical mechanics

1. Introduction.
2. Forces.
3. Graphic statics.
4. Forces in space.
5. Center of parallel forces and the center of gravity of a body.
6. Friction.
7. Dynamics.
8. Elements of the theory of mechanisms and machines.

Strength of materials

1. Introduction.
2. Attraction and pressure.
3. Shearing.
4. Flexion.
5. Torsion.
6. Buckling.
7. Complex cases of deformation.
8. Strength at time of action of dynamic forces.

Machine details

1. Introduction.
2. Permanent connections.
3. Dismountable connections.
4. Means of passing on movement.
5. Shafts, axles, journals.
6. Bearings.
7. Clutches.
8. Simple hoisting machines.
9. Design of machine details.

Electricity theory

1. Electrodynamics
   - a. Introduction, load, tension, current.
   - b. Electric resistance.
   - c. Consumer connections.
   - d. Connection of current sources.
   - e. Direct current circuits and network calculation.
   - f. Work and capacity in electricity.
2. Magnetism and electromagnetism
   - a. Magnetic phenomena and magnetic fields.
   - b. Electromagnetic fields.
   - c. Magnetic properties of materials.
   - d. Magnetic circuits.
   - e. Forces of energy in a magnetic field.
   - f. Electromagnetic induction.
3. Electrochemistry
   - a. Basic electrochemical phenomena.
   - b. Primary cells.
   - c. Secondary cells.
4. Miscellaneous electrical phenomena
   - a. Thermoelectric phenomena.
   - b. Photoelectric phenomena.
5. Electrostatics
   - a. Basic phenomena.
   - b. Electrostatic field.
   - c. Condensator.
   - d. Forces and energy in an electrostatic field.

6. Field of current

7. Alternating current

   a. Phenomena and definitions of alternating current.
   b. Different forms of expression of sinuous dimensions.
   c. Series circuit of single-phase alternating (sinuous) current.
   d. Parallel circuit in single-phase alternating current.
   e. Analysis of single-phase alternating current circuits by determining geometrical position.
   f. Calculation of networks in single-phase alternating current.
   g. Coupled circuits.
   h. Multi-phase systems.

8. Transients

9. Harmonics

   a. Analysis of non-sinuous recurring dimension.
   b. Calculations in non-sinuous dimensions.
   c. Harmonics in circuits.

Materials and electrical installations

1. Technology of electric materials.
   a. Electric materials (classification, production and general properties).
   b. Electrical properties of materials.
   c. Mechanical properties of materials.
   d. Thermic properties of materials.

2. Installation materials - properties and structure

3. Electrical calculations for electrical installation

4. Mechanical calculations for electrical installation

5. Instructions and regulations for installing apparatus

6. Installations of a special nature

   a. Installations in places of supply with special features.
   b. High power installations.
   c. Installations fed on high tension or on tension and/or frequencies differing from those of the national network.
   d. Open-air installations.
   e. Temporary installations.

7. Power stations, electricity networks

   a. Review of power stations and transformation.
   b. Types of network.
   c. Main materials for mounting overhead and underground networks.
   d. Principles of determining network routes.
   e. Connection of supply to network.
   f. Regulations for the mounting of the network according to the electricity law.
   g. Main schemes of network, group network.
   h. Protection of network.

8. Principles of control and monitoring

9. Light theory and lighting installations

   a. Introduction to the theory of light.
   b. Sources of light.
   c. Lighting accessories, illuminating bodies.
   d. Quantitative calculations of light.
   e. Planning of lighting installations.

10. Mechanical mounting of equipment

   a. Tools and instruments for mechanical mounting.
   b. Transfer and hoisting of heavy equipment.
   c. Bases for heavy equipment.
   d. Centralization and lines of equipment.
   e. Control and prevention of vibration.
   f. Safety in installation work, labour regulations.

11. Survey, examination, maintenance and repair of installations

12. Design of electrical installations

13. Electrical systems in various plants and installations

Measurement of electricity

1. General

   a. Structure of measuring instruments.
   b. Precision of measurement.
   c. Moments.

2. Classification of measuring instruments

   a. Moving coil instruments.
   b. Measuring instruments with crossed coils.
   c. Measuring instruments with moving magnet.
   d. Soft iron measuring instruments.
   e. Instruments based on thermic action.
   f. Electrodynamic and prodynamic measuring instruments.
   g. Electrostatic instruments.
   h. Inductive instruments.
   i. Oscillatory measuring instruments.
   j. Miscellaneous measuring instruments (in principle).

3. Methods of measuring electrical magnitudes

    a. Measurement of voltage.
    b. Measurement of current.
    c. Measurement of resistance.
    d. Measurement of impedance, reactance, capacitance and inductance.
    e. Universal measuring instruments.
    f. Measurement of output.
    g. Measurement of energy.
    h. Measurement of power factor.
    i. Measurement of frequency.
    j. Measurement of magnetism.

4. Measurement of non-electrical magnitudes by electrical methods

Electrical machines

1. Direct current machines

    a. The basic machine for direct current (definitions and structure).
    b. The magnetic circuit for a vacuum machine with direct current.
    c. Winding and E.M.F. of the rotor in a direct current machine.
    d. Reaction of rotor.
    e. Commutation.
    f. Losses and efficiency of electrical machines (general).
    g. Direct current generators.
    h. Parallel activity of generators.
    i. Direct current motors.
    j. Special direct current motors.
    k. Principles of calculation and planning of direct current machines.

2. Transformators.

    a. Definitions, classification and structure of transformators.
    b. Physical elements in the operation of transformators.
    c. Single-phase transformators in vacuum.
    d. Three-phase transformators (principle of action and connections).
    e. Three-phase transformators in vacuum.

f. Operation of transformators in short circuit.
g. Operation of transformators under load.
h. Three-phase transformators with non-symetrical load.
i. Parallel operation of transformators.
j. Transition effects in transformators.
k. Protection of transformators.
l. Special transformators (structure, operation, use).
m. Calculation and planning of various transformators.

3. Alternating current machines (general)

a. Basic machines for alternating current - structure and principle of operation.
b. Electromotive forces in winding in alternating current machines.
c. Methods of winding in alternating current machines (diagrams and equations.
d. Increase of temperature and cooking of electrical machines.

4. Synchronomous machines

a. Reaction of the armature in symmetrical load.
b. Diagrams of dials of three-phase generator in symmetrical load.
c. Single phase synchronous generator.
d. Characteristics curves of the synchronous generator.
e. Parallel operation of synchronous machines (synchronization).
f. Synchronous machines and synchronous capacitors.
g. Review of stable asymmetrical work conditions in three-phase synchronous generators.
h. Review of the phenomenon of the sudden short-circuit in synchronous generators.
i. Review of vibrations in synchronous machines.
j. The synchronous converter.

5. Asynchronous machines (inductive machines)

   a. Immobile three-phase inductive machines (non rotating).
   b. Mobile three-phase inductive machines (rotating rotor).
   c. Moments in inductive machines.
   d. Circuit diagrams in inductive machines.
   e. Starting of asynchronous three-phase motors.
   f. Regulation of the number of revolutions in three-phase inductive motors.
   g. Single-phase inductive machines.
   h. Calculation and planning of asynchronous machines.

6. Collector machines in alternating current

   a. General problems of collector machines in alternating current.
   b. Single-phase collector motors.
   c. Three-phase collector motors.
   d. Connections of cascades in inductive machines and collector machines.

7. Rectifiers

Motion, regulation control

1. Electrical regulation and motion

   a. Basic principles.
   b. Direct current motor.
   c. Asynchronous motor.
   d. Synchronous motor.
   e. Transients in electric motion.
   f. Choice of appropriate motor.
   g. Modern methods in the technique of electric motion.

2. Control theory

   a. Introduction.
   b. Differential equations of control systems.
   c. First sequence systems.
   d. Second sequence systems.
   e. Transmission functions.
   f. Stability of linear control systems.
   g. Control components.
   h. Simulation of central systems by analogy computer.

Electrical goods and appliances industry

1. General nature of production in the electrical industry.
2. Electrical appliances industry.
3. Contacts and elements of contacts.
4. Coils for high currents and hard and soft connections.
5. Coils of winding wires.
6. Magnetic circuits.
7. Resistance and heat elements.
8. Planning of transmitters for direct current and alternating current.
9. Production of electrical appliances (Israeli standard number 621.365).
10. Production of electrical machines.

Measurement laboratories and apparatus

1. Acquaintance with measuring instruments and laboratory equipment; safety rules in the laboratory.
2. Comparison of instructions of different types of measuring instruments.
3. Measurement of current and voltage - direct and alternating.
4. Regulation of current and voltage - direct and alternating.
5. Calibration of ammeters and voltmeters.
6. Measurement of output and work in single-phase circuits.
7. Calibration of output meter and other meters.
8. Phase regulation.
9. Measurement of power factor and its improvement.

10. Measurement of resistances in various fields (current and voltage, bridges, ohmm meter, megger and other methods).
11. Measurement in circuits for direct current (Kirchhoff laws, etc.).
12. Potentiometer for direct current and E.M.F.
13. Determination of consumption of measuring instruments.
14. Change of measurement range of instruments.
15. Characteristic curves of rectifiers and valves.
16. Characterisitc curves of fuses and transmitters.
17. Measurement in symmetrical and non-symmetrical three-phase fuses (currents, voltages, output, work).
18. Measurement in circuits in alternating circuits (resonance circuits and bridges in alternating current).
19. Magnetic measurements (experiments and demonstrations of magnetic phenomena, magnetization curve, iron output, etc.).
20. Measurement of temperature by electrical methods.
21. Measurement of earths.
22. Tests of accumulators.

Electrical machine laboratory

1. Experiments with direct current machine.
2. Experiments with transformers.
3. Experiments with asynchronous machines.
4. Experiments with synchronous machines.
5. Experiments with alternating current collector machines, rectifiers, and special machines (amplidin, magnetic amplifier).
6. Fault localization.

Projects

1. Planning and calculation exercises (work carried out in the course of study).

   a. Electrical installations: much time should be devoted to exercises in planning and calculation of installations and guidance in the use of books, catalogues and tables.

   1. Planning of terminal panels.
   2. Planning of lighting installations.
   3. Planning of machine installations.
   4. Planning of control installations.
   5. Planning of connection of a plant to the national network.
   6. Planning of an installation's consumption.
   7. Preparation of specifications (kind and type of installation materials, execution of installation works, various construction works etc.).

   b. Electrical machines.

   1. Planning and construction of single-phase and three-phase generators, including electrical and economic calculations.
   2. Planning of stator and rotor windings of synchronous and asynchronous machines. Planning and calculation of constructive details.
   3. Planning of winding in direct current machines.
   4. Planning and calculation of rectifying system.

   c. Electrical goods industry.

   Planning of electrical goods and various instruments taking into account the following factors: the nature of the production and production processes, the constructive form, the materials and their properties, the processing installations, etc.

Electricity and network theory

1. Current load and network; resistance.
2. Electrical circuit in direct current.
3. Work and output in direct current circuits.
4. Network calculation in direct current.
5. Magnetism.
6. The capacitor and its capacitance.
7. Alternating current circuits.
8. Dual systems (four-terminal network).
9. Electrochemistry.
10. Electrostatics.
11. Non-sinusoidal waves.
12. Transients.

General electronics

1. Introduction: the science of electronics.
2. Vacuum tube.
3. Semi-conductors.
4. Voltage amplifiers.

Electronics and industrial electronics

1. Electronic tubes.
2. Semi-conductors.
3. Rectifiers and rectifying circuits.
4. Amplifying circuits.
5. Regulating rectifiers.
6. Oscillators.
7. Special effects and their use.
8. Measuring instruments.
9. Industrial electronics.

Mechanical workshop

1. Hand metalwork.
2. Machines and tools.
3. Welding.
4. Miscellaneous.

Electricity workshop

1. Basic exercises.
2. Lighting and power installations.
3. Electrical instruments and winding.
4. Machines and installations for machines.
5. Visits to industry.
6. Power amplifiers.
7. Supply power.
8. Direct current amplifier (transistor circuits only).
9. Tuner amplifiers (tube and transistor, class A only).
10. Oscillators.

Law of measurements

Structure and principles of operation of measuring instruments

Instruments with fixed magnet.

Extension of range of measurement (parameter and serial resistor).

Adjustment of instrument with fixed magnet to measurement in alternating current.

Electrostatic instrument.

Review of various measuring instruments (moving iron inductive, electrodynamic, heating wire).

Properties and requirements of instruments.

Calculation and estimation of errors in measurement.

Current and voltage measurement.

Measurement of resistance of impedances.

Measurement of power (small power and high frequencies).
Review and explanation of multimeters.
Tube and circuit voltmeters.
Oscilloscope circuits.
Scaling circuit.
Principles of measurement of non-electrical magnitudes by electrical means.

Electrical machines

Introduction to three-phase systems.
Repetition of electromagnetism.
Asynchronous machines.
Synchronous machines.
Direct current machines.
Rotary converters.
Synchronous instruments.
Reception and transmission.
Section 1 - Class A amplifiers.
Section 2 - Modulators (amplitude modulation only).
Section 3 - Transmitters.
Section 4 - Receivers.
Section 5 - Transmitters and receivers for frequency modulation.
Section 6 - Transmission lines.
Section 7 - Aerials and wave propagation.

Industrial electronics

Pulse theory.
Introduction to the theory of regulation.
Theory.
Components.
Analog computer.
Digital computer.

Heat engineering

Introduction.
Ideal gases.
Concepts of work, output and efficiency.
Basic laws of thermodynamics.
Thermometer.
Internal combustion engines.
Pumps and pistons.
Steam.
Steam systems.
Flow of gases.
Turbines, jet engines, exploitation of energy.
Cooling installations.
Changing of heat.
Power stations.

Fundamentals of television

1. Review of the optical and physiological problems of the eye.
2. Elements of light theory.

Communications and communications apparatus

1. Transmission lines (for linear communication).
2. Repeaters.
3. Carriers.
4. Measurements in linear communication.

Automation and telemechanics

1. Basic concepts.
2. Linear systems.
3. Non-linear networks.
4. Electromechanical and electronic switching.

Constructions and production

1. Specifications.
2. Preparation of production.
3. Construction of a prototype.
4. Fundamentals of correct planning.
5. Construction.
6. Mass production.
7. Administrative, economic and technical structure of manufacturing enterprises.

V.H.F.

Introduction.
Maxwell laws.
Characteristic waves and wave conductors.
Resonant circuit in the form of a hollow body and filters.
Aerials.
Electronic waves and currents.

Klystrons

Tubes with moving waves and tubes with many electronic currents.

Magnetrons

Microwave systems; transition stations

Radar

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